OVERHILLS STREAM AND WETLAND RESTORATION

MONITORING REPORT (YEAR 2 OF 5)

Harnett County, North Carolina
NCEEP Project Number 199

Prepared for:
North Carolina Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

Status of Plan: Final
Submission Date: April 2009

Monitoring Firm:

Stantec Consulting Services Inc
801 Jones Franklin Road, Suite 300
Raleigh, NC 27606

EXECUTIVE SUMMARY

Project Background

The North Carolina Ecosystem Enhancement Program (NCEEP) restored 4,482 linear feet of Jumping Run Creek and 70 acres of adjacent riverine wetlands located on the Fort Bragg Overhills tract, north of Spring Lake, in Harnett County, North Carolina. Construction of the project began on July 12, 2004 and the restoration was completed on May 30, 2006. The following report provides the monitoring information for year two (2) of the stream and wetland restoration project. The project consists of a portion of Jumping Run Creek and the adjacent riverine wetland. The site is located on the Fort Bragg Military Reservation in Harnett County, North Carolina and can be accessed from Nursery Road between NC 87 and Overhills Road. Project goals and objectives for the Overhills stream restoration project included restoration of stream dimension, pattern, and profile; restoration of riverine wetland hydrology and vegetation; improvement of water quality; and protection of future water quality. Jumping Run Creek had been significantly altered from its natural path prior to the restoration efforts. The channel has been relocated to the far edge of its floodplain. The purpose of this type of relocation was typically to improve drainage of the surrounding area and create a large field for agricultural purposes. The adjacent riverine wetlands were also significantly altered due to the stream relocation. In addition, a ditch was created on the eastern edge of the property. Undeveloped forested land is located to the east and west of the project site. An agricultural field is located to the north and Nursery Road serves as the southern boundary. The Jumping Run Creek watershed is comprised of a mixture of undeveloped forested land, wetlands, suburban residential areas, commercial areas, and a large golf course community. The watershed has a drainage area of 15.9 square miles. The topography of the watershed is typical sandhills type topography which is rolling in nature.

Vegetation Assessment

The Carolina Vegetation Survey (CVS) Level 2 methodology was utilized to sample vegetation in October of 2008. Ten 100m^2 plots have been established throughout the project. In each plot, two plot corners have been permanently located with conduit or rebar. As per the mitigation plan, the vegetative success criteria are based on the US Army Corps of Engineers Stream Mitigation Guidelines (USACE, 2003). The final vegetative success criteria will be the survival of 260 5-year old planted trees per acre at the end of the year 5 monitoring period. An interim measure of vegetation planting success will be the survival of at least 320 3-year old planted trees per acre at the end of year 3 of the monitoring period. Seven of the plots have over 320 stems per acre while three of the plots have less than 320 stems per acre. This is an increase in the number of plots meeting the 3-year vegetative success criteria when compared to last year. Plot 9 did not meet the criteria in Year 1, with 283 stems per acre. In addition to the three failing vegetation plot sites, several vegetation problem areas (VPA) exist onsite. In VPA 1 and 2, persistent flooding has occurred and has caused the majority of the planted vegetation to die. Standing water continues to be present in VPA 1. VPA 3 is currently overrun with invasive species, primarily *Lespedeza. Lespedeza* continues to be a major problem on the project site. It is invading dry areas, especially on top of the berms onsite.

Stream Assessment

As per the request of NCEEP, the Overhills Stream Restoration project was monitored as two separate reaches in Monitoring Year 2. The Upper Reach, classified as a Rosgen C5 stream, runs from the

beginning of the project at Station 0+00 to Station 33+00. The Lower Reach, a Rosgen E5 stream, runs from 33+00 to the end of the project at Station 44+00. A new riffle cross-section, Cross Section 9, was added in order to provide sufficient cross-sectional data for the Lower Reach. Other cross-sectional changes this year include the re-designation of Cross Section 7 as a riffle. This cross-section had been designed as a riffle, but had been referred to as a pool cross-section in the previous year's monitoring report as it exhibited some pool-like characteristics.

A major stream problem area is located from station 32+60 to 44+00 where the stream has experienced serious failure. At the downstream end of the Upper Reach, a headcut was first noted to have developed near Station 32+80 in Year 1 monitoring. This headcut continues to move steadily upstream, appearing to have moved approximately 20 feet upstream to Station 32+60 since last year. The headcut most likely first began at the location where the design changes from a C5 to E5 channel between the Upper and Lower reaches at Station 33+00. Downstream from this headcut, most of the in-stream structures have failed and erosion is occurring. Mid-channel bar formation is also occurring along the reach. There was also a lack of geotextile fabric in the installation and the angle of the structure was not optimal to reduce near bank sheer stress and bank scour. The beaver dam near Station 6+30 continues to cause problems such as scour and excessive sediment deposition. Minor scouring and sediment deposition was also observed around the two smaller beaver dams present at the time of the stream monitoring survey on August 12, 2008. The beaver dams were located at Stations 23+15 and 27+77. These are both shown on the longitudinal profiles and monitoring plan view; however, they were not present during the latest site visit in November of 2008. Significant storm events during the early fall most likely washed the dams downstream. Minor problem areas such as bank scour and floodplains with little to no vegetation were found from Station 0+00 to Station 32+00 of the restoration reach, but overall this area of the restoration appears to be stable.

Wetland Assessment

Fifteen groundwater monitoring wells are currently active on the project site. All 15 wells met the success criteria during the growing season of 2008. The reference well also met the success criteria, with a maximum of 71 consecutive days of saturation within 12 inches of the ground surface. Precipitation this year fell between the 30th and 70th percentiles for all months during the growing season except March, June and October, which fell just below the 30th percentile. April and September precipitation fell above the 70th percentile.

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1.0 Project Background

The project consists of a portion of Jumping Run Creek and the adjacent riverine wetland. The site is located on the Fort Bragg Military Reservation in Harnett County, North Carolina.

1.1 PROJECT OBJECTIVES

Project goals and objectives for the Overhills stream and wetland restoration project included:

- restore stream dimension, pattern and profile
- restore riverine wetland hydrology and vegetation
- improve water quality
- protect future water quality

1.2 PROJECT STRUCTURE

The project consists of a portion of Jumping Run Creek and the adjacent riverine wetland. The site is located on the Fort Bragg Military Reservation in Harnett County, North Carolina.

Jumping Run Creek has been significantly altered from its natural path prior to the restoration efforts. The channel was relocated to the far edge of its floodplain. The purpose of this type of relocation was typically to improve drainage of the surrounding area and create a large field for agricultural purposes. The existing channel was dug approximately 5-8 feet deep and about 15 feet wide at the stream bed to 20+ feet wide at the top of bank. The stream classification system for the existing reach of this project was a G4/G5c. The adjacent riverine wetlands had also been significantly altered due to the stream relocation as well as a ditch that was created on the eastern edge of the property.

Priority 1 stream restoration was carried out on the entire reach resulting in restored C & E type channels. Type C design was implemented from the start of the project (Station 0+00) until Station 33+00. Type E design was used as a step-down to the receiving stream from this point until the project end. For the remainder of this report, the C channel will be referred to as the Upper Reach and the E channel will be referred to as the Lower Reach. The pattern, dimension, and profile were restored throughout the project site by relocating the entire reach of stream. Log structures and root wads were installed to provide grade control, extra bank protection, and encourage development of bedform features. In wetland restoration areas, a mixture of grading to create microtopography, channel plugs, and berms were used to manipulate and enhance the hydrology of the site. Two vegetative zones were planted in the project area. Cypress gum swamp was planted throughout the riverine wetland and more bottomland hardwood species were planted along the stream corridor.

Exhibit Table I. Project Restoration Components Overhills/Jumping Run Creek Restoration Project - EEP Project No. 199						
	Existing Feet/Acres	Type	Approach	Footage or Acreage	Stationing	Comment
Upper Reach	3064	R	P1	3270	0+00 to 33+00	Includes log structures and root wads
Lower Reach		R	P1	1212	33+00 to 44+00	Includes log structures and root wads; step-down to existing channel
Riparian Wetlands	NA	R	-	70.0		Floodplain of restored stream
R = Restoration						
P1 = Priority 1						

1.3 LOCATION AND SETTING

The restoration site is located on the Fort Bragg Military Reservation in Harnett County, North Carolina and can be accessed from Nursery Road between NC 87 and Overhills Road (Figure 1).

Undeveloped forested land is located to the east and west of the project site. An agricultural field is located to the north and Nursery Road serves as the southern boundary. The Jumping Run Creek watershed is comprised of a mixture of undeveloped forested land, wetlands, suburban residential areas, commercial areas, and a large golf course community. The watershed has a drainage area of 15.9 square miles. The topography of the watershed is typical sandhills type topography which is rolling in nature.

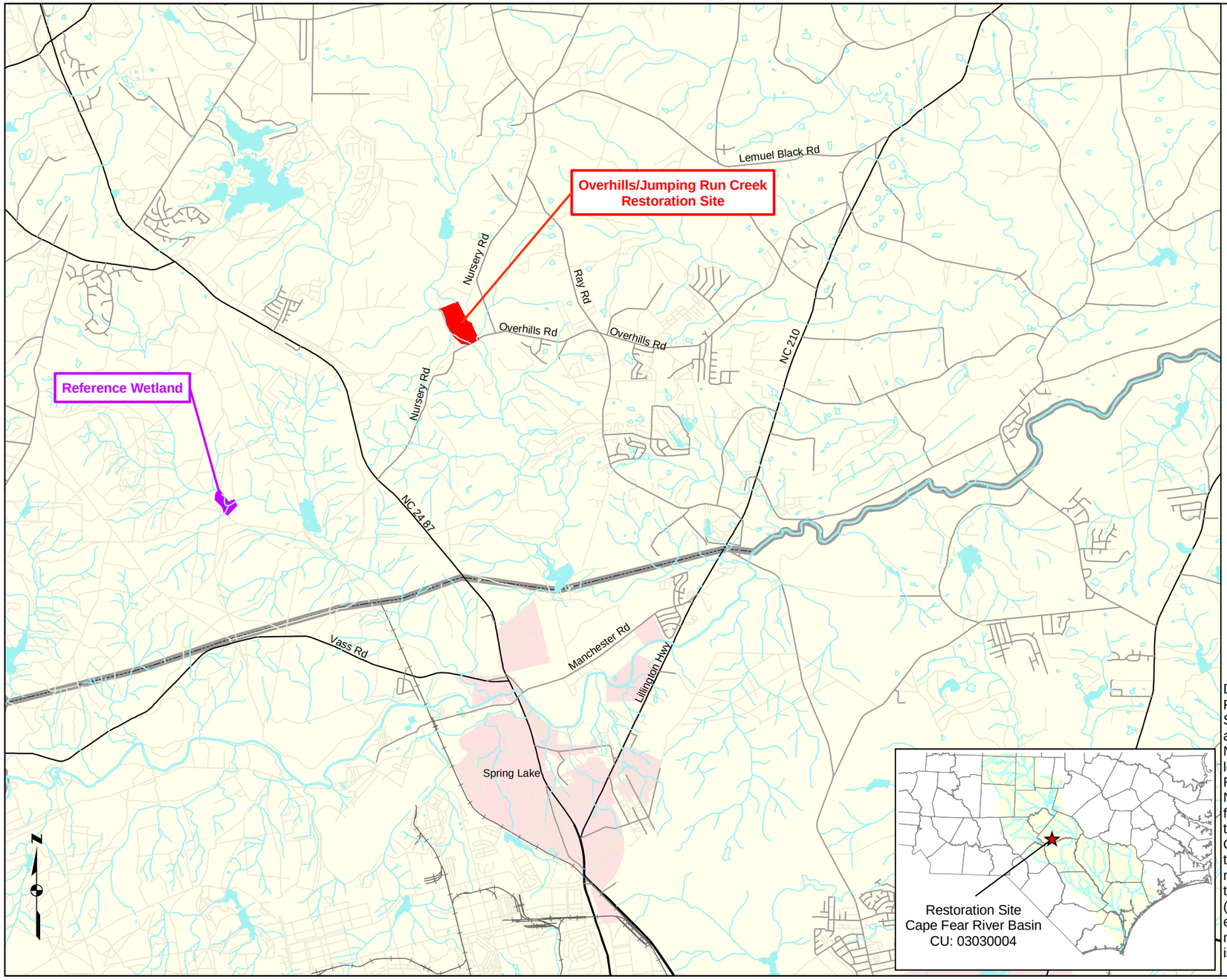

Figure 1. Location Map

Overhills/Jumping Run Creek Stream and Wetland Restoration Project
EEP #: 0199
Harnett County, North Carolina

Monitoring Report
November 2008

0 0.5 1 2 3Miles

- 1:24000 Hydrography
- NCDOT Primary Roads
- NCDOT Secondary Roads
- Railroads
- Overhills/Jumping Run Creek
  35.258N, 79.000W
- Reference Wetland
  35.227N, 79.050W

Directions to Overhills/Jumping Run Creek Restoration Site: From Raleigh, take US401 South following signs through Fuquay-Varina and into downtown Lillington. Turn right onto NC 27 and follow for about 9 miles, then turn left onto Nursery Rd. After 6.5 miles, Nursery Rd will come to a T, turn right to stay on Nursery Rd. The restoration site is half a mile from the T on the right hand side. To get to the reference site from the restoration site: Continue travelling east on Nursery Rd for 2 miles, then turn left onto NC24/NC87 for 3 miles. Turn right onto Vass Rd/NC 690. Continue for 3.5 miles, then turn right at sign that states "NO POVs" (this is part of Fort Bragg, need permission to enter). Follow the dirt road straight, at least 1.7 miles (do not turn or veer). The reference well is in the woods, about 100 feet from the end of the road.

1.4 PROJECT HISTORY AND BACKGROUND

Exhibit Table II. Project Activity and Reporting History Overhills/Jumping Run Creek Restoration Project - EEP Project No. 199		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan	NA	March 2003
Final Design - 90%	NA	Dec 2003
Construction	NA	June 2006
Temporary S&E mix applied to entire project area	NA	2004
Permanent seed mix applied to entire project area	NA	Nov 2004
Bare root, containers, and live stakes for majority of site	NA	Dec 2004
Water released into new channel	NA	Oct 2005
Permanent seed mix applied to entire project area	NA	Nov 2005
Bare root, containers, and live stakes for remainder of site	NA	Dec 2005
Mitigation Plan / As-built (Year 0 Monitoring - baseline)	July 2007	Nov 2007
Year 1 Monitoring	Nov 2007	Nov 2007
Year 2 Monitoring	Nov 2008	Nov 2008
Year 3 Monitoring	NA	NA
Year 4 Monitoring	NA	NA
Year 5 Monitoring	NA	NA

NA = Not Applicable

Exhibit Table III. Contacts Overhills/Jumping Run Creek Restoration Project - EEP Project No. 199	
Designer	BLUE: Land Water Infrastructure 1271 Old US Highway #1 South Southern Pines, NC 28387 Phone: 910-692-6461
Construction Contractor	Vaughn Contracting, Inc P.O. Box 796 Wadesboro, NC 28170 Phone: 704-694-6450
Surveying Subcontractor	Barbara H. Mulkey Engineers, Inc 7516 E. Independence Blvd, Suite 100 Charlotte, NC 28227 Phone: 704-537-7300
Site Preparation Subcontractor	Herndon, Inc P.O. Box 36 Lugoff, SC 29078 Phone: 803-513-8002
Erosion Control Subcontractor	Carolina Environmental Contractors, Inc P.O. Box 1905 Monut Airy, NC 27030 Phone: 336-320-3849
Vegetation Planting Contractor & Nursery Stock Supplier for livestakes and potted plants	North State Environmental, Inc 2889 Lowery Street Winston-Salem, NC 27101 Phone: 339-725-2010
Nursery Stock Supplier for bare roots	International Paper
Seed Mix Sources	Unknown/Info Not Available
Monitoring Performers	Stantec Consulting Services, Inc 801 Jones Franklin Rd, Ste 300 Raleigh, NC 27606
Stream Monitoring POC Vegetation Monitoring POC Wetland Monitoring POC	David Bidelspach 919-851-6866 Amber Coleman 919-851-6866 Amber Coleman 919-851-6866

Exhibit Table IV. Project Background Table Overhills/Jumping Run Creek Restoration Project - EEP Project No. 199	
Project County	Harnett County
Drainage Area	15.9 square miles
Drainage impervious cover estimate (%)	5%
Stream Order	3rd
Physiographic Region	Sandhills
Ecoregion	Sandhills
Rosgen Classification of As-built	C5
Cowardin Classification	Palustrine
Dominant soil types	
Upper Reach	Roanoke
Lower Reach	Roanoke
Wetland	Roanoke
Reference site ID	Gum Swamp
USGS HUC for Project	03030004
USGS 14-Digit HUC for Project	03030004090010
USGS HUC for Reference	03030004
USGS 14-Digit HUC for Reference	03030004080090
NCDWQ Subbasin for Project	03-16-14
NCDWQ Subbasin for Reference	03-16-13
NCDWQ Classification for Project	C
NCDWQ Classification for Reference	C
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No

1.5 MONITORING PLAN VIEW

See Monitoring Plan View Sheets on the following pages.

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Overhills Monitoring Plan View

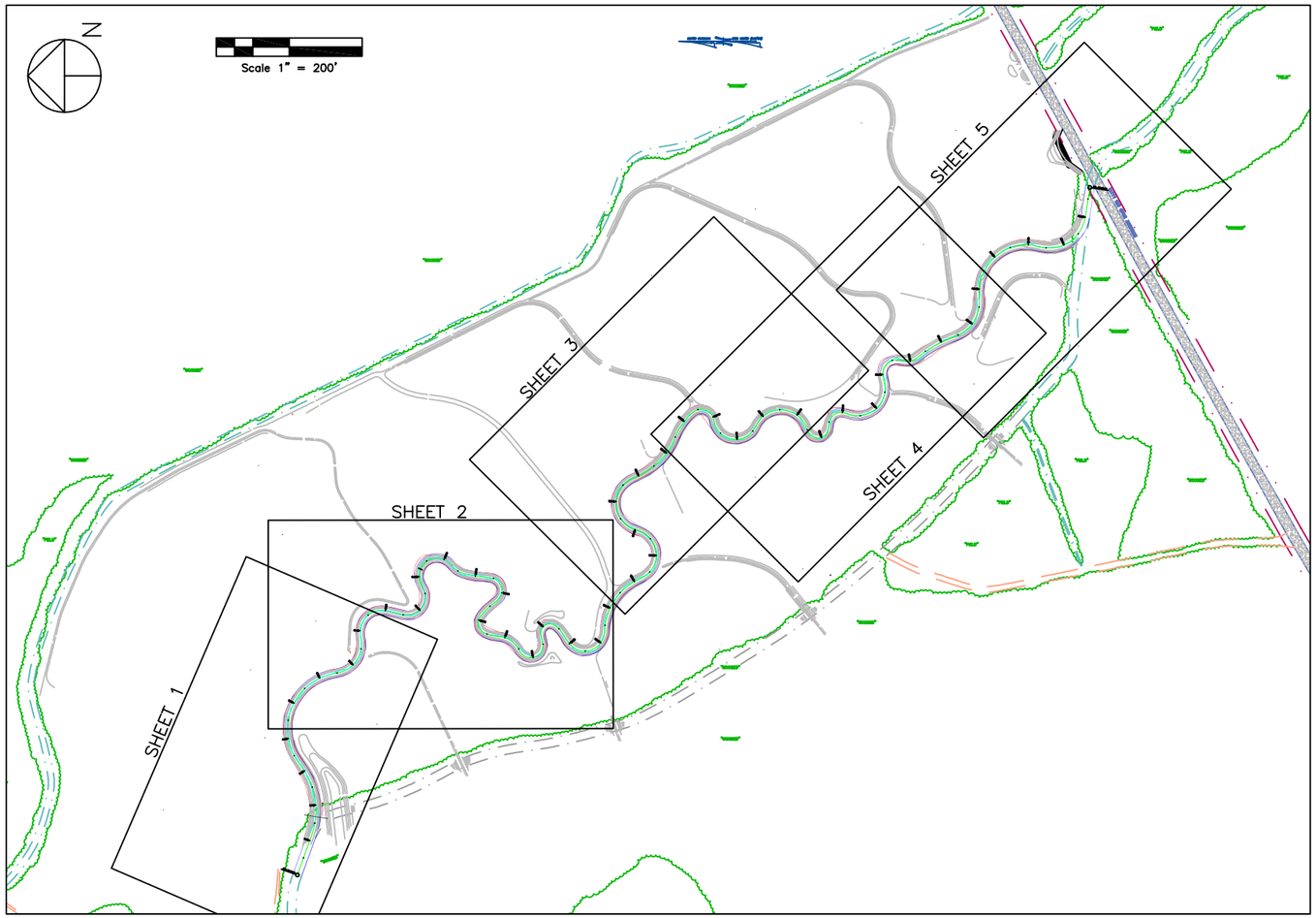
(Nursery Road)

Jumping Run Creek / McLeod's Creek

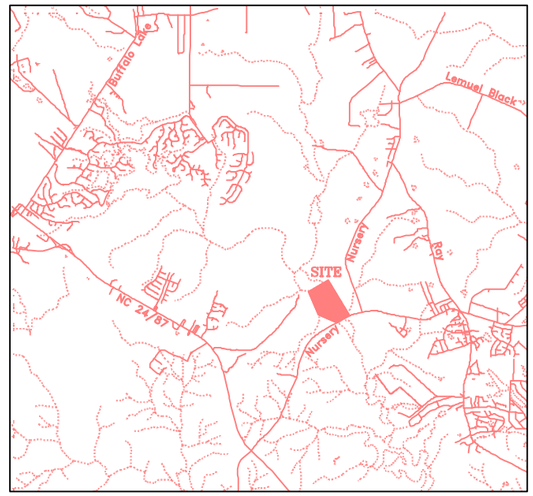
Stream and Wetland Restoration Project

Harnett County, North Carolina

SITE



VICINITY



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AS–BUILT PROJECT ENGINEER SIGNATURE

ORIGINAL STREAM RESTORATION DESIGN BY:
BLUE: LAND, WATER, INFRASTRUCTURE, PA

Prepared For: The NC Ecosystem Enhancement Program (NCEEP)

April, 2009

Monitoring Plan View

LEGEND

- DESIGN THALWEG
- AS-BUILT BANKFULL
- DESIGN BANKFULL
- MONITORING LONGITUDINAL PROFILE
- DESIGN GRADE
- DESIGN LOG CROSS VANE
- DESIGN ROOT WAD
- VEG PLOT PINS
- VEG PLOTS
- CROSS-SECTIONS
- PHOTO POINTS

CROSS SECTION PIN LOCATIONS		
PIN	LAT	LONG
XS1PL	35.26109096	-79.00252352
XS1PR	35.26124247	-79.00249424
XS2PL	35.26081361	-79.00061178
XS2PR	35.26072332	-79.00069698

VEG PLOT PIN COORDINATES		
PIN	LAT	LONG
VP1	35.26080136	-79.00066535
VP1	35.26092137	-79.00083395
VP7	35.26053462	-79.00144889
VP7	35.26064411	-79.00136751

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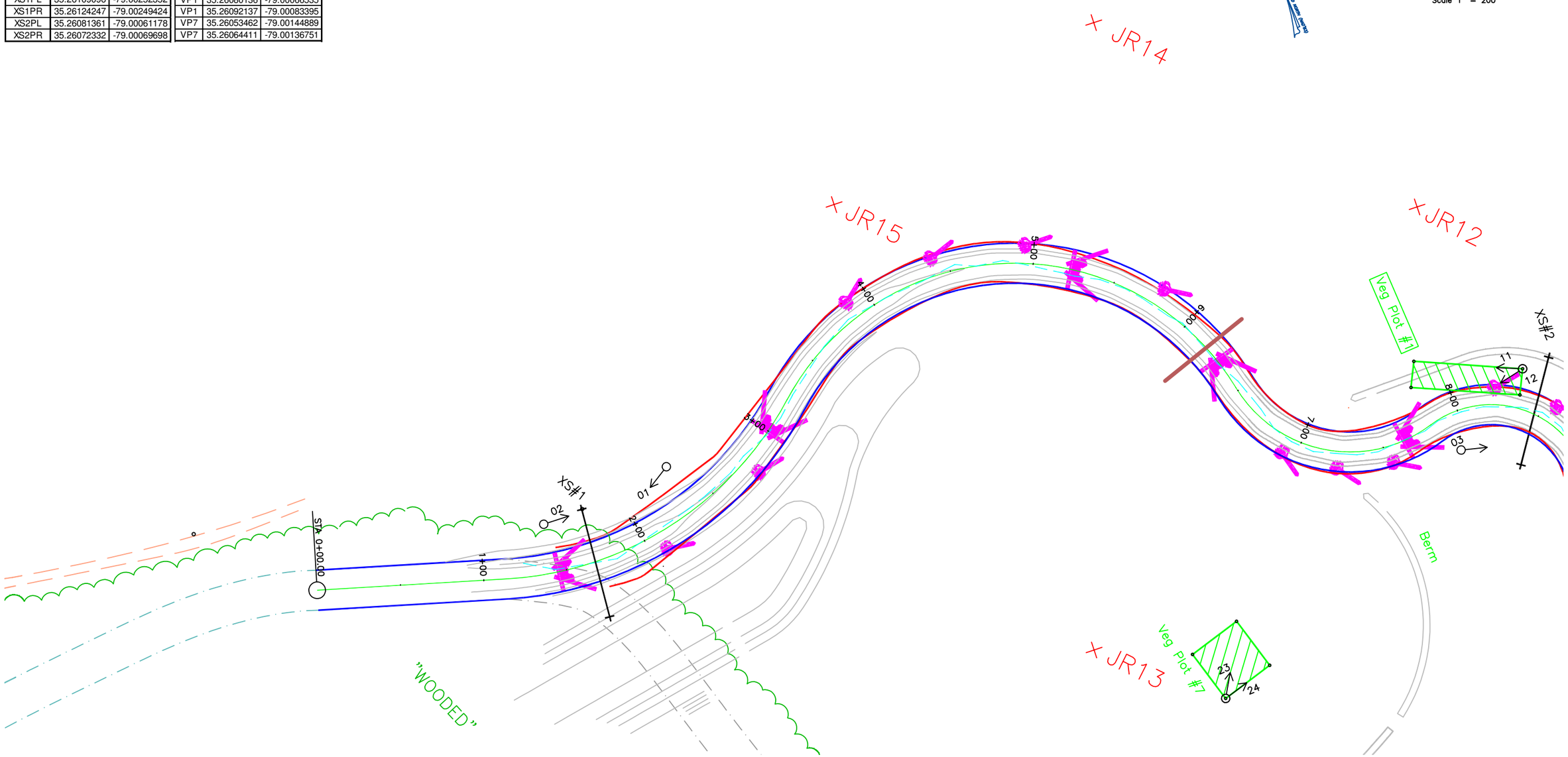
PROJECT NO.	SHEET NO.
SCO#070695701	01
AS-BUILT PROJECT ENGINEER	

Scale 1" = 200'



Monitoring Plan View

PROJECT NO.	SHEET NO.
SCO#070695701	02
AS-BUILT PROJECT ENGINEER	

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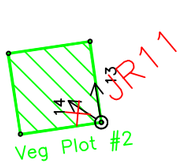
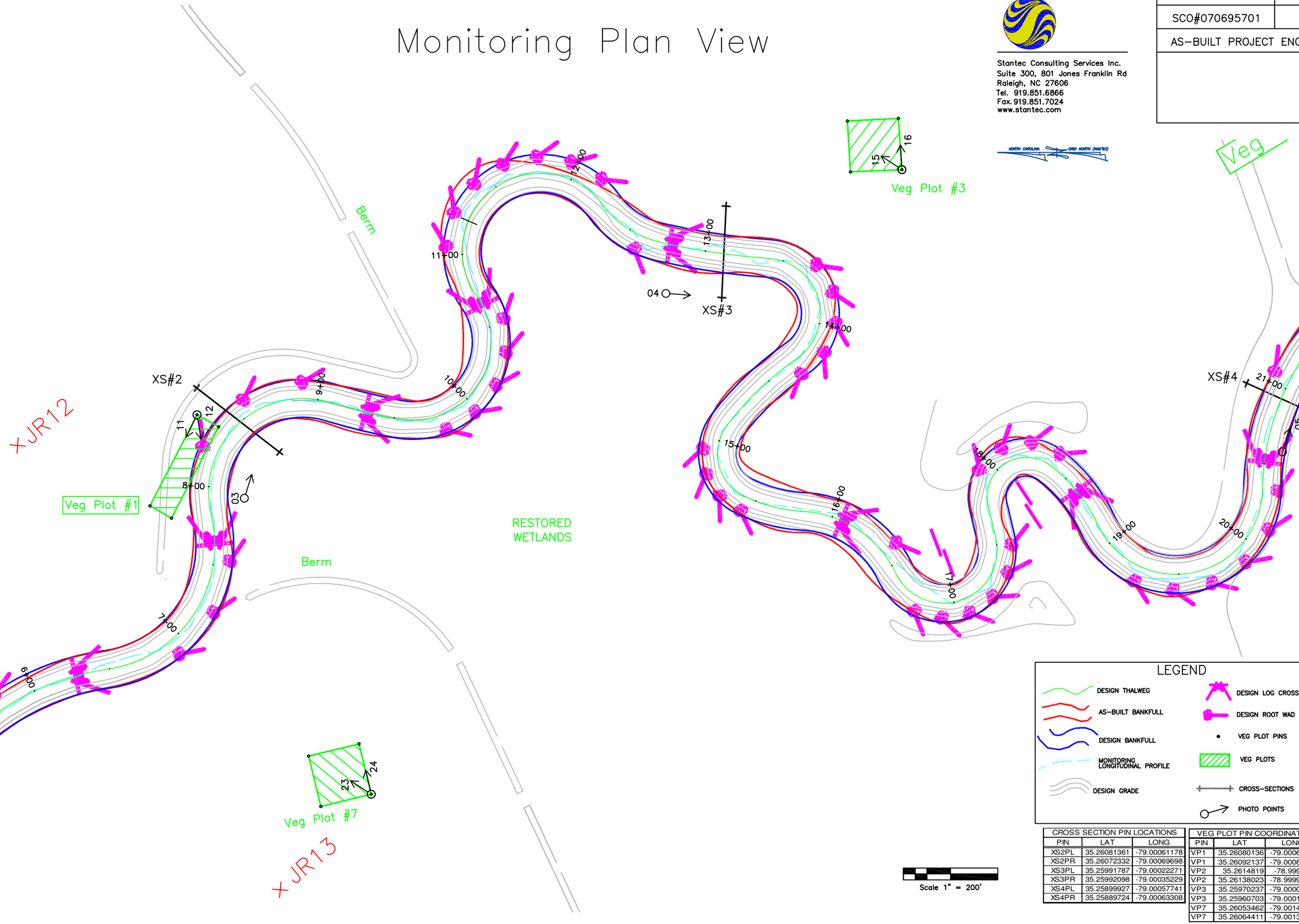
NORTH CAROLINA GRID NORTH (NAD'83)





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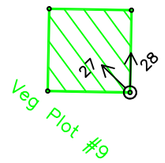
- VEG PLOTS
- CROSS-SECTIONS
- PHOTO POINTS

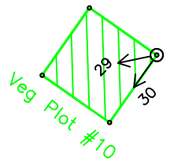
Scale 1" = 200'

CROSS SECTION PIN LOCATIONS		
PIN	LAT	LONG
XS2PL	35.26081361	-79.00061178
XS2PR	35.26072332	-79.00069698
XS3PL	35.25991787	-79.00022271
XS3PR	35.25992098	-79.00035229
XS4PL	35.25899927	-79.00057741
XS4PR	35.25889724	-79.00063308

VEG PLOT PIN COORDINATES		
PIN	LAT	LONG
VP1	35.26080136	-79.00066535
VP1	35.26092137	-79.00083395
VP2	35.2614819	-78.9998302
VP2	35.26138023	-78.99992232
VP3	35.25970237	-79.00001297
VP3	35.25960703	-79.00011682
VP7	35.26053462	-79.00144889
VP7	35.26064411	-79.00136751

Monitoring Plan View





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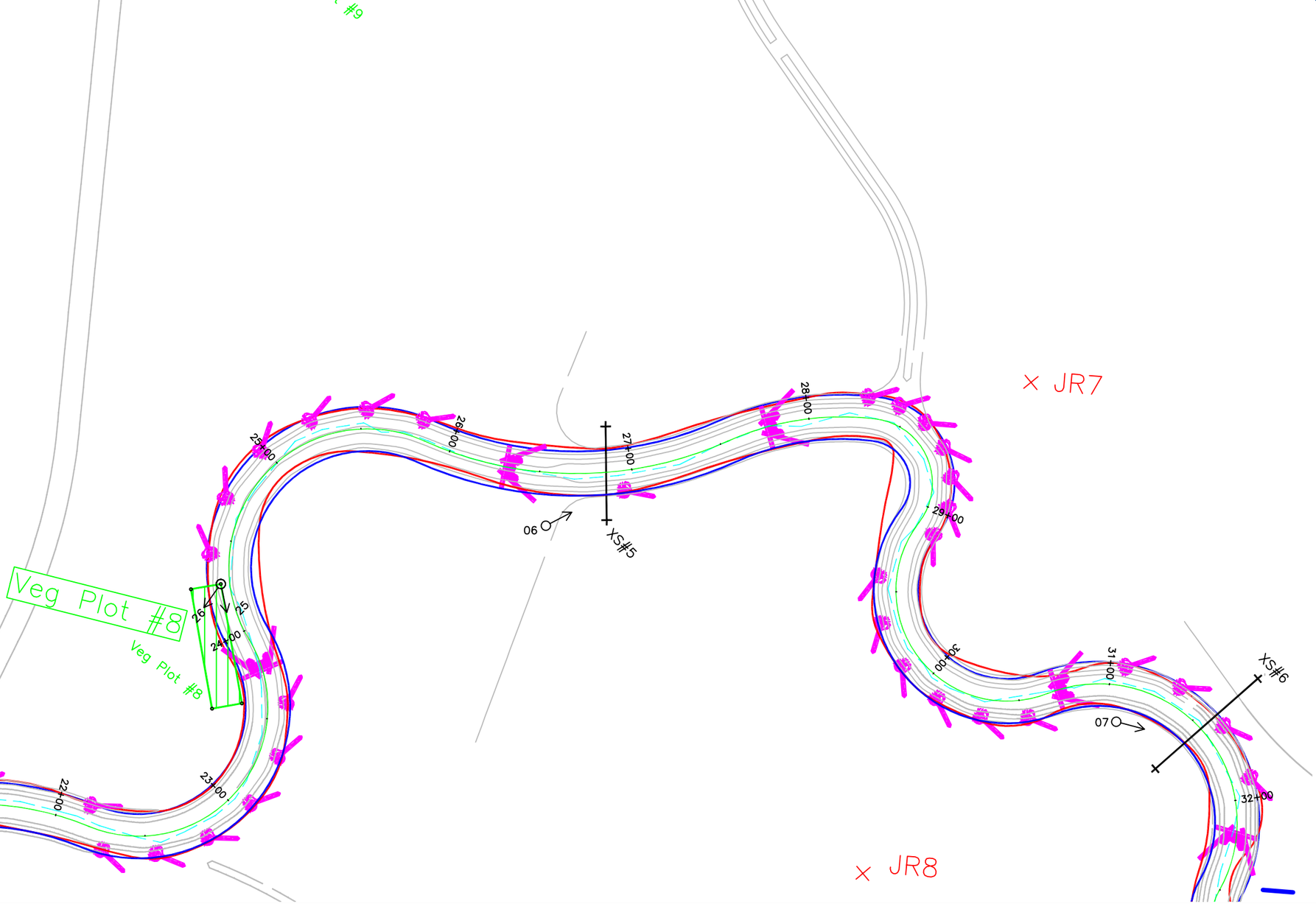
PROJECT NO.	SHEET NO.
SCO#070695701	03
AS-BUILT PROJECT ENGINEER	

Scale 1" = 200'



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- DESIGN LOG CROSS VANE
- DESIGN ROOT WAD
- VEG PLOT PINS
- VEG PLOTS
- CROSS-SECTIONS
- PHOTO POINTS

CROSS SECTION PIN LOCATIONS		
PIN	LAT	LONG
XS5PL	35.25857955	-78.99914964
XS5PR	35.25849085	-78.99925158
XS6PL	35.25763716	-78.99869711
XS6PR	35.25764396	-78.99883106

VEG PLOT PIN COORDINATES		
PIN	LAT	LONG
VP8	35.25882237	-78.99983412
VP8	35.25870055	-79.00000515
VP9	35.25930164	-78.99884514
VP9	35.25942907	-78.99884242
VP10	35.25851643	-78.99760386
VP10	35.25858954	-78.99773114

Monitoring Plan View

PROJECT NO.	SHEET NO.
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AS-BUILT PROJECT ENGINEER	

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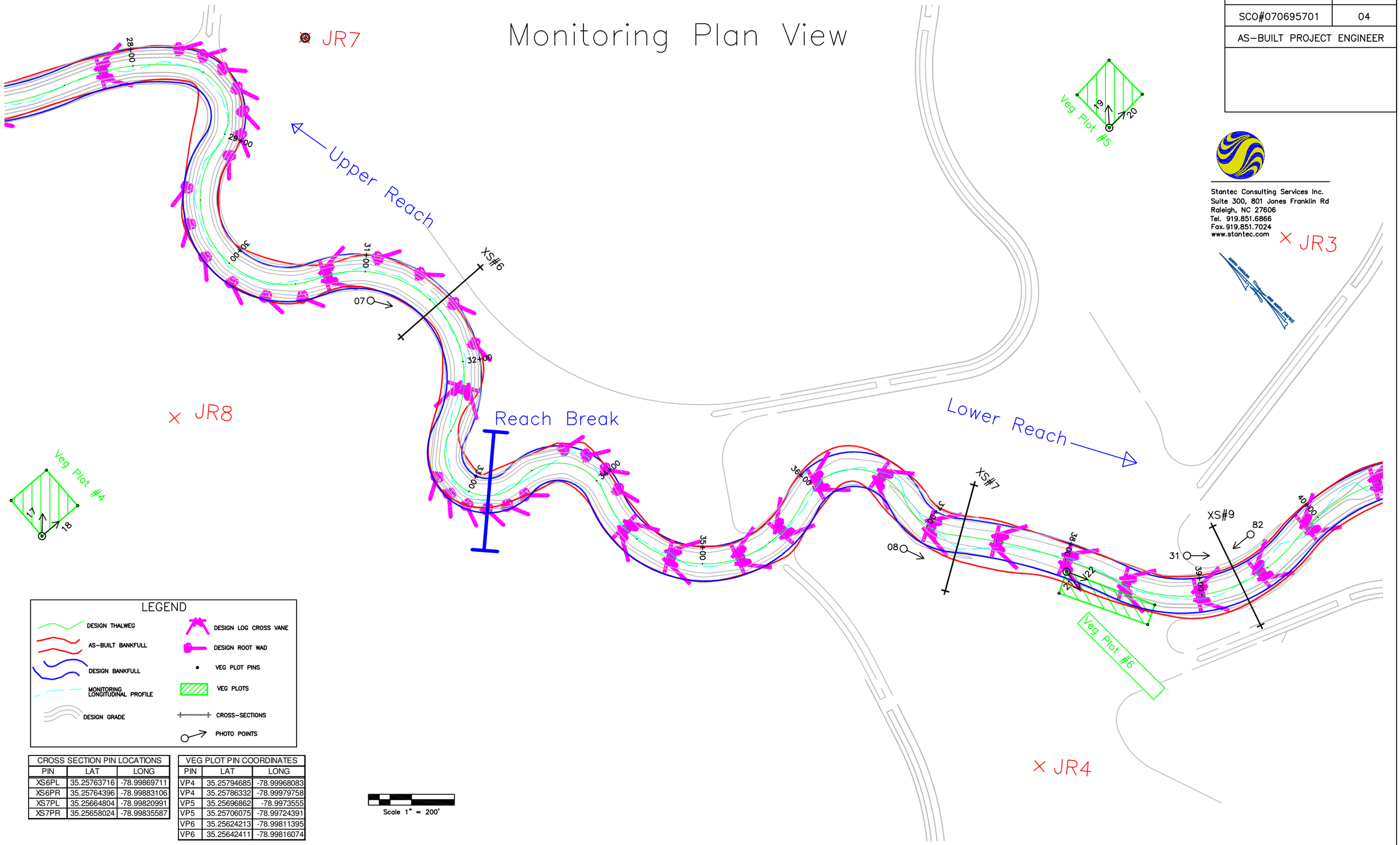

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CROSS SECTION PIN LOCATIONS		
PIN	LAT	LONG
XS6PL	35.25763716	-78.99869711
XS6PR	35.25764396	-78.99883106
XS7PL	35.25664804	-78.99820991
XS7PR	35.25658024	-78.99835587

VEG PLOT PIN COORDINATES		
PIN	LAT	LONG
VP4	35.25794685	-78.99968083
VP4	35.25786332	-78.99979758
VP5	35.25696862	-78.9973555
VP5	35.25706075	-78.99724391
VP6	35.25624213	-78.99811395
VP6	35.25642411	-78.99816074

Scale 1" = 200'

Monitoring Plan View

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PROJECT NO.	SHEET NO.
SCO#070695701	05
AS-BUILT PROJECT ENGINEER	

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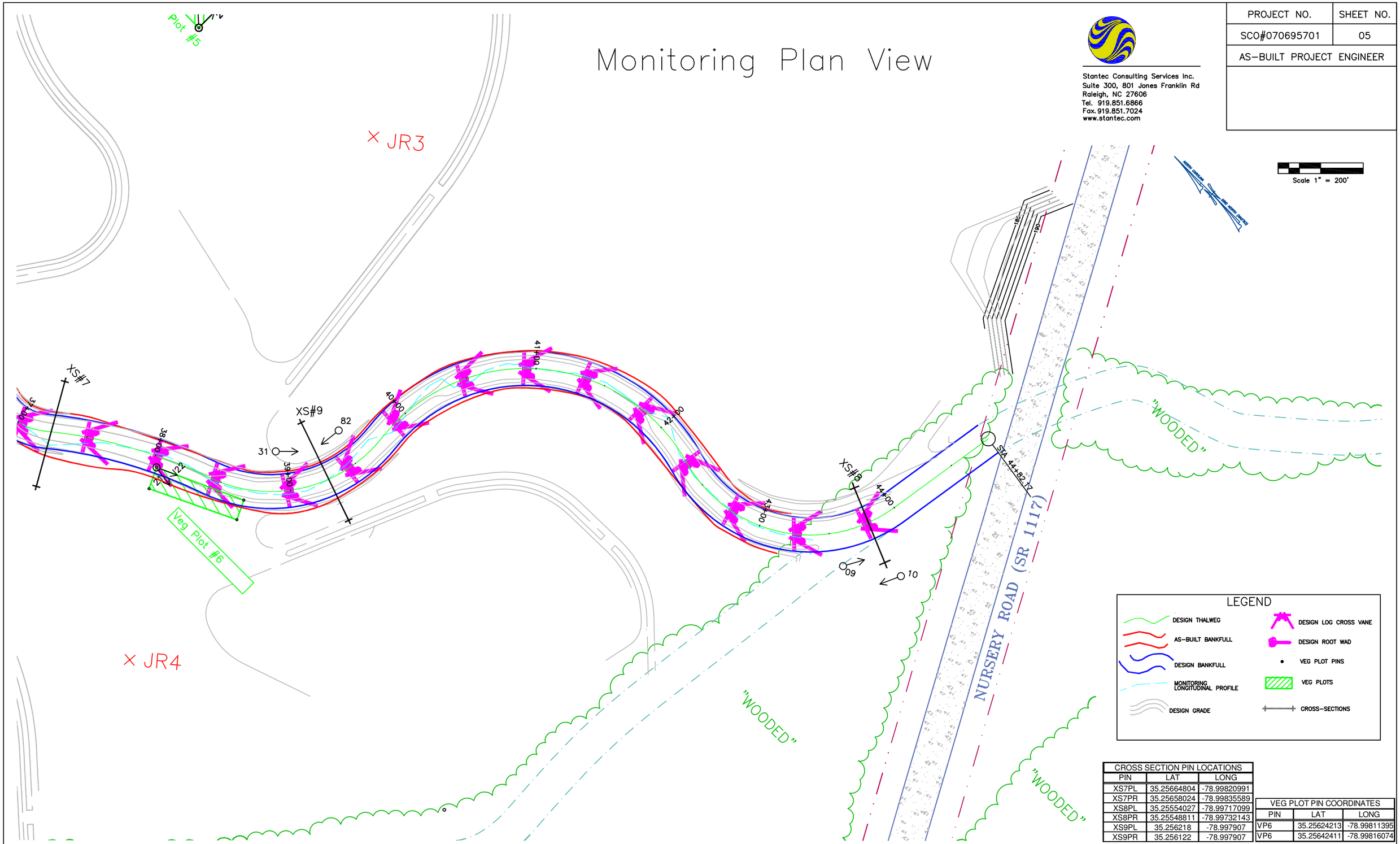

CROSS SECTION PIN LOCATIONS		
PIN	LAT	LONG
XS7PL	35.25664804	-78.99820991
XS7PR	35.25658024	-78.99835589
XS8PL	35.25554027	-78.99717099
XS8PR	35.25548811	-78.99732143
XS9PL	35.256218	-78.997907
XS9PR	35.256122	-78.997907

VEG PLOT PIN COORDINATES		
PIN	LAT	LONG
VP6	35.25624213	-78.99811395
VP6	35.25642411	-78.99816074

Monitoring Plan View

LEGEND

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- DESIGN GRADE
- DESIGN LOG CROSS VANE
- DESIGN ROOT WAD
- VEG PLOT PINS
- VEG PLOTS
- CROSS-SECTIONS
- × JR10 MONITORING WELLS

Scale 1" = 200'

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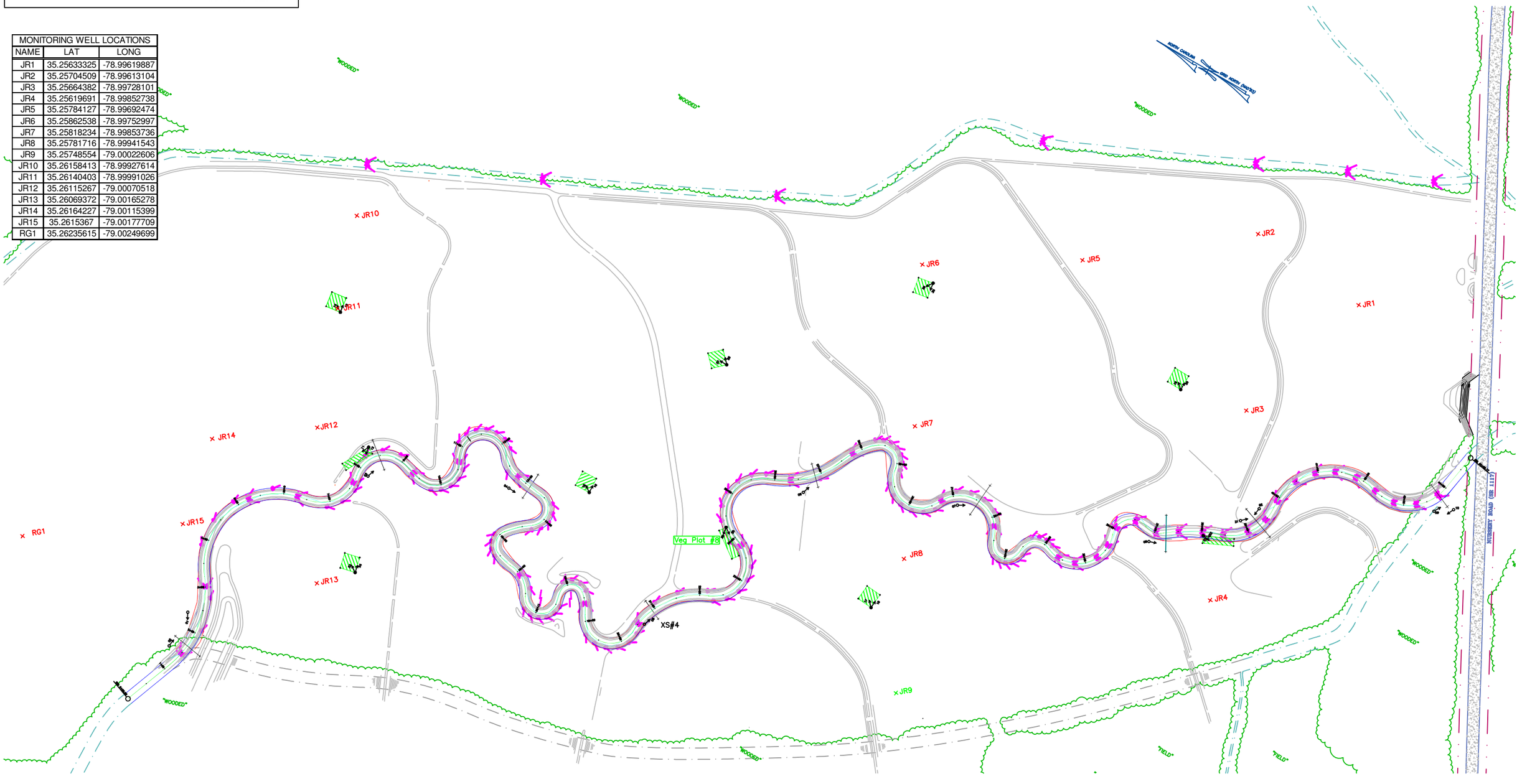
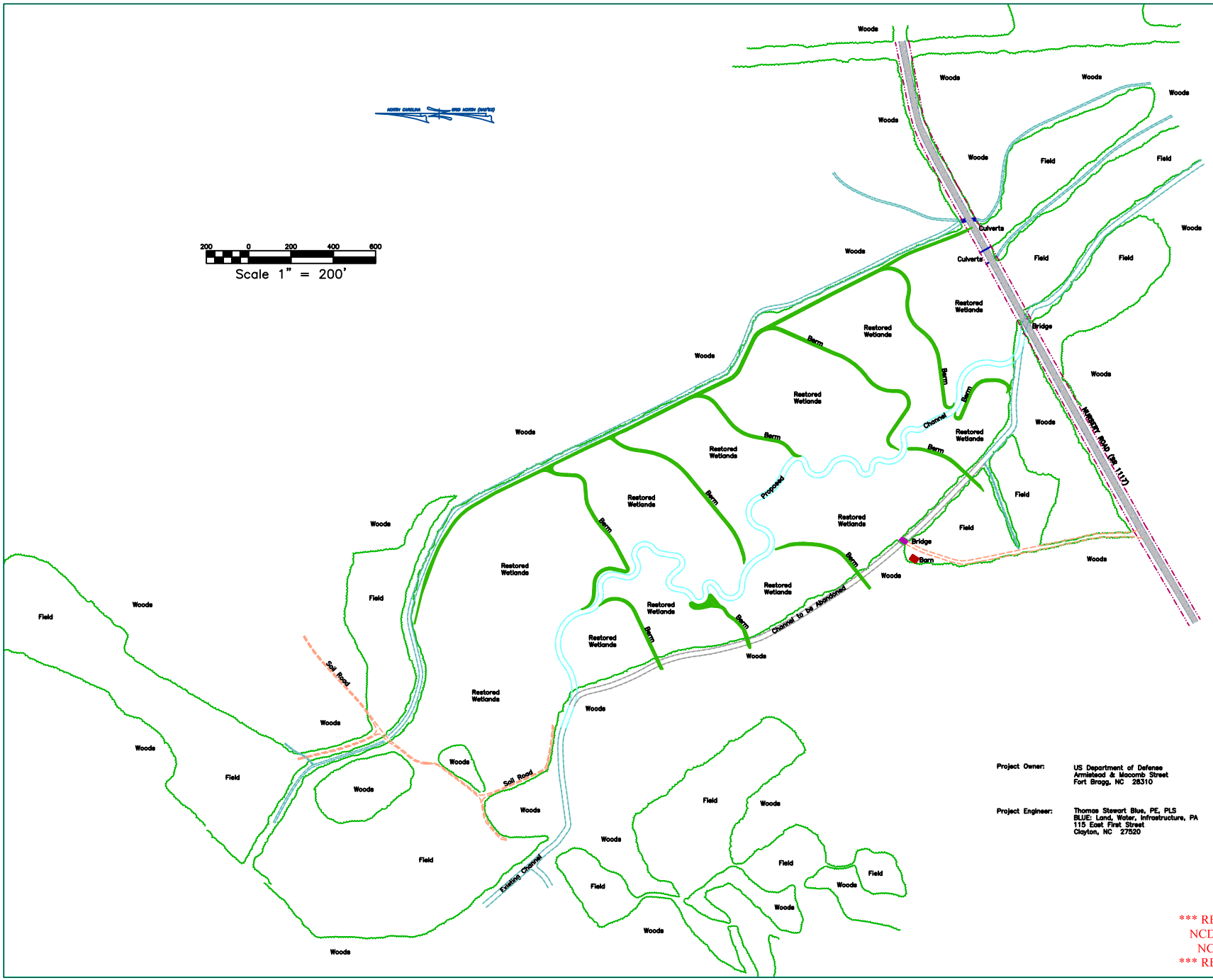
PROJECT NO.	SHEET NO.
SCO#070695701	06
AS-BUILT PROJECT ENGINEER	

MONITORING WELL LOCATIONS

NAME	LAT	LONG
JR1	35.25633325	-78.99619887
JR2	35.25704509	-78.99613104
JR3	35.25664382	-78.99728101
JR4	35.25619691	-78.99852738
JR5	35.25784127	-78.99692474
JR6	35.25862538	-78.99752997
JR7	35.25818234	-78.99853736
JR8	35.25781716	-78.99941543
JR9	35.25748554	-79.00022606
JR10	35.26158413	-78.99927614
JR11	35.26140403	-78.99991026
JR12	35.26115267	-79.00070518
JR13	35.26069372	-79.00165278
JR14	35.26164227	-79.00115399
JR15	35.2615367	-79.00177709
RG1	35.26235615	-79.00249699





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NCEEP Project: JR/CF/01
*** RECORD DOCUMENT ***

BLUE Land Water Infrastructure, PA
115 East First Street
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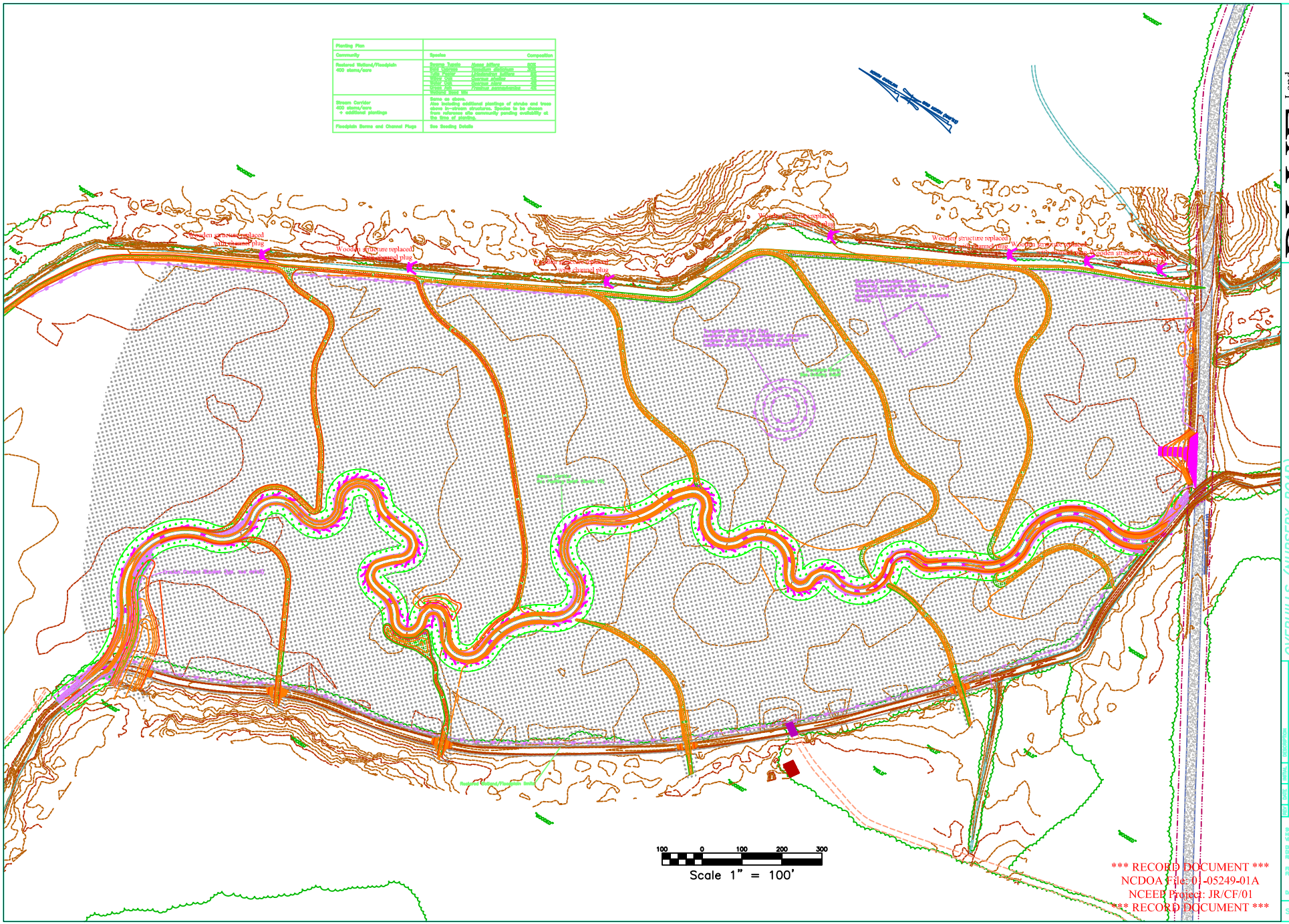
OVERHILLS (NURSERY ROAD)
HARNETT COUNTY, NORTH CAROLINA
SCHEMATIC LAYOUT

PREPARED FOR:
The North Carolina Wetlands Restoration Program
320 West Jones Street
Raleigh, NC 27603

NO. | DATE | BY | DESCRIPTION

SCALE:
HORIZONTAL: 1" = 200'
VERTICAL: N/A
DRAWN BY: MSS
DESIGNED BY: TSB/KLB
REVIEWED BY: TSB/KLB/MSS
FILE NAME: 010263AC.DWG
FIELD BOOK: N/A
DATE: 12/01/03

SHEET 2 OF 19



*** RECORD DOCUMENT ***
NCDOA File: 01-05249-01A
NCEEP Project: JR/CF/01
*** RECORD DOCUMENT ***

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OVERHILLS (NURSERY ROAD)
HARNETT COUNTY, NORTH CAROLINA
PLANTINGS / EROSION CONTROL

PREPARED FOR:
Ecosystem Enhancing Wetlands Restoration Program
320 West Jones Street
Raleigh, NC 27603

SCALE:
HORIZONTAL: 1" = 100'
VERTICAL: N/A
DRAWN BY: MSS
DESIGNED BY: TSB/KLB
REVIEWED BY: TSB/KLB/MSS
FILE NAME: 010263AC.DWG
FIELD BOOK: N/A
DATE: 12/01/03

SHEET 16 OF 19

2.0 Project Condition and Monitoring Results

2.1 VEGETATION ASSESSMENT

The Carolina Vegetation Survey (CVS) Level 2 methodology was utilized to sample vegetation in September of 2008. Ten 100m^2 plots have been established throughout the project. In each plot, two plot corners have been permanently located with conduit or rebar.

As per the mitigation plan, the vegetative success criteria are based on the US Army Corps of Engineers Stream Mitigation Guidelines (USACE, 2003). The final vegetative success criteria will be the survival of 260 5-year old planted trees per acre at the end of the year 5 monitoring period. An interim measure of vegetation planting success will be the survival of at least 320 3-year old planted trees per acre at the end of year 3 of the monitoring period.

The Year 2 stem counts within each of the vegetative monitoring plots are included in Exhibit Tables A1 through A5 in Appendix A. Seven of the plots have over 320 stems per acre while three of the plots have less than 320 stems per acre. This is a reported increase in the number of plots meeting the 3-year vegetative success criteria when compared to last year. In monitoring Year 2 a planted *Nyssa biflora* was observed in Plot 9 which had been overlooked in the previous year's monitoring. As such, with the inclusion of this plant Plot 9 now meets the success criteria in both years of monitoring.

2.1.1 Vegetation Problem Areas

In addition to the three failing vegetation plot sites, much of the same vegetation problem areas continue to exist onsite. These sites are referred to as VPA 1, 2, & 3 on the Integrated Current Condition Plan View located in Appendix D. In VPA 1 and 2, persistent flooding has occurred and has caused the majority of the planted woody vegetation to die (Photos 1 & 2 in Appendix A.2). Standing water continues to be present in VPA 1. VPA 3 is currently overrun with invasive species, primarily *Lespedeza* (Photo 3). *Lespedeza* continues to be a major problem on the project site. It is invading dry areas, especially on top of the berms onsite.

2.1.2 Vegetation Current Condition Plan View

Vegetative problem areas are shown on the Integrated Current Condition Plan View in Appendix D.

2.2 STREAM ASSESSMENT

As per the request of NCEEP, the Overhills restoration project was monitored as two separate reaches in Monitoring Year 2. The Upper Reach, classified as a Rosgen C5 stream, runs from the beginning of the project at Station 0+00 to Station 33+00. The Lower Reach, a Rosgen E5 stream, runs from 33+00 to the end of the project at Station 44+00. A new riffle cross-section, Cross Section 9, was added in order to provide sufficient cross-sectional data for the Lower Reach. Other cross-sectional changes this year include the re-designation of Cross Section 7 as a riffle. This cross-section had been designed as a riffle,

but had been referred to as a pool cross-section in the previous year's monitoring report as it exhibited some pool-like characteristics.

2.2.1 Hydrology

A crest gauge was found onsite during the February field visit and is believed to have been placed there prior to the Year 1 monitoring. However, no markings were found on the gauge and therefore cannot be used to verify bankfull events. Other evidence of bankfull events has been observed onsite during field reconnaissance. During a site visit in November of 2008, there was evidence of flooding as seen by flattened vegetation and sediment deposits on the floodplain near Vegetation Plot 3 (Appendix B.4, Photo 1). This likely occurred when Hurricane Hanna passed through the area on September 7, 2008.

Exhibit Table V. Verification of Bankfull Events
Overhills/Jumping Run Creek Restoration Project - EEP Project No. 199

Date of Data Collection	Date of Occurrence	Method	Photo
2008	September, 2008	Field observation	Appendix B.4, Photo 1

2.2.2 Stream Problem Areas

A major stream problem area is located from station 32+60 to 44+00 where the stream has experienced serious failure. At the downstream end of the Upper Reach, a headcut was first noted to have developed near Station 32+80 in Year 1 monitoring. This headcut continues to move steadily upstream, appearing to have moved approximately 20 feet upstream to Station 32+60 since last year. The headcut most likely first began at the location where the design changes from a C to E type channel between the Upper and Lower reaches at Station 33+00. Downstream from this headcut, most of the in-stream structures have failed. Erosion around the structures has forced the banks to migrate as much as seven feet, making this section of stream extremely unstable (SPA Photo 1&2). Mid-channel bar formation is also occurring along the reach (SPA Photo 5). The headcut and downstream problems are apparent in the longitudinal profile of the channel. The survey data suggest that this section of the stream may not have been transitioned to the existing stream properly. There was a lack of geotextile fabric in the installation and the angle of the structure was not optimal to reduce near bank sheer stress and bank scour.

Minor problem areas such as bank scour and bare floodplains were found from Station 0+00 to Station 32+00 (Upper Reach) of the restoration reach (SPA Photo 4), but overall this area of the restoration appears to be stable (Appendix B.4, Photo 2). Normal water surface elevations are at or near the constructed bankfull, allowing the channel to access the floodplain under very small storm events, reducing shear stress in the channel. The areas immediately surrounding the channel were ponded near the channel banks. The beaver dam near Station 6+30 continues to cause problems such as scour and excessive sediment deposition. Minor scouring and sediment deposition was also observed around the two smaller beaver dams present at the time of the stream monitoring survey on August 12, 2008. The beaver dams were located at Stations 23+15 and 27+77. These are both shown on the longitudinal profiles and monitoring plan view; however, they were not present during the latest site visit in November of 2008. Significant storm events during the early fall most likely washed the dams downstream.

Other problems include downcutting at cross-sections (XS) 4 and 7. At XS4, the stream appears to have incised from the baseline survey to Monitoring Year 1; however, the stream appears relatively stable from

monitoring year 1 to Monitoring Year 2. The initial downcutting was most likely attributed to an undersized channel upstream. In addition, the upstream log cross-vane appears to have failed by not holding the grade of the bed during Year 1. XS7, which is located in the unstable downstream reach, provides evidence that this portion of the reach is actively degrading. The bed will most likely continue to downcut until a less erosive bed layer emerges in the profile to stop the incising. Two log cross-vanes, both upstream and downstream of the cross-section, have failed to hold grade and are contributing additionally to the active degradation of the stream bed.

2.2.3 Stream Current Condition Plan View

Stream problem areas are shown on the Integrated Current Condition Plan View in Appendix D.

2.2.4 Stability Assessment

Exhibit Table VI-A. Categorical Stream Feature Visual Stability Assessment
Overhills/Jumping Run Creek Upper Reach- EEP Project No. 199

Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles	76%	76%	100%			
B. Pools	70%	70%	95%			
C. Thalweg	77%	77%	100%			
D. Meanders	91%	91%	100%			
E. Bed General	75%	75%	97%			
F. Bank Condition	74%	73%	97%			
G. Vanes / J Hooks, etc.	36%	34%	77%			
H. Wads and Boulders	65%	63%	NA			

Exhibit Table VI-B. Categorical Stream Feature Visual Stability Assessment
Overhills/Jumping Run Creek Lower Reach- EEP Project No. 199

Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles	76%	76%	29%			
B. Pools	70%	70%	50%			
C. Thalweg	77%	77%	0%			
D. Meanders	91%	91%	47%			
E. Bed General	75%	75%	50%			
F. Bank Condition	74%	73%	0%			
G. Vanes / J Hooks, etc.	36%	34%	0%			
H. Wads and Boulders	65%	63%	NA			

**Initial and MY-01 include entire stream restoration reach.*

2.2.5 Quantitative Measures Summary

Exhibit Table VII. Baseline Morphology and Hydraulics Summary
Overhills/Jumping Run Creek Restoration Project - EEP Project No. 199

Parameter	USGS Gage Data			Regional Curve Interval			Pre-Existing Condition			Project Stream Reference			Design			Baseline		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
BF Width (ft)							11.7	15.9	14.5	10.8	20.4	14.4	21.0	25.0	22.5	18.5	23.2	20.1
Flood Prone Width (ft)							-	-	16.5	-	-	200.0	-	-	200	-	-	>200
BF Cross Sectional Area (SF)							54.6	77.5	56.7	13.5	22.1	21.0	35.0	46	41	23.0	49.0	36.0
BF Mean Depth (ft)							2.4	2.5	2.50	1.0	2.7	2.7	2.5	2.5	2.5	1.2	2.7	1.7
BF Max Depth (ft)							2.4	2.5	2.5	1.8	4.2	3.2	2.5	2.5	2.5	2.4	4.8	2.9
Width/Depth Ratio							4.9	6.4	5.8	4.1	8	5.4	8.4	10	9	7.8	15.5	11.7
Entrenchment Ratio							-	-	1.2	-	-	13.9	-	-	8.9	-	-	9.3
Bank Height Ratio							2.5	0.8	2.4	0.6	1.5	1.2	1.0	2.4	1.2	1.0	1.0	1.0
Wetted Perimeter (ft)							-	-	-	-	-	-	-	-	-	19.2	32.6	25.3
Hydraulic Radius (ft)							-	-	-	-	-	-	-	-	-	1.2	3.5	2.2
Pattern																		
Channel Beltwidth (ft)							-	-	600	45	110	77	80	200	110	48	149	100
Radius of Curvature (ft)							-	235	235	12	30	23.4	30	175	80	30	167	68.0
Meander Wavelength (ft)							315	660	500	125	175	150	125	250	200	10	276	220
Meander Width ratio							21.8	45.6	3.5	8.7	12.2	10.4	5.6	11.1	8.9	6.40	13.00	10.10
Profile																		
Riffle Length							-	-	-	-	-	-	-	-	-	12	183	72
Riffle Slope							-	-	-	-	-	-	-	-	-	0.0500	0.1100	0.0810
Pool Length							-	-	-	-	-	-	-	-	-	8	116	151
Pool Spacing							-	-	-	-	-	-	-	-	-	39	231.00	121
Substrate																		
d50 (mm)							0.5	9	0.5	0.58	0.65	0.62	0.5	9	0.5	0.09	0.27	0.21
d84 (mm)							2.6	30	2.6	1.7	1.7	1.7	2.6	30	2.6	0.36	0.44	0.4
Additional Reach Parameters																		
Valley Length (ft)							-	-	2808	-	-	230	-	-	2444	-	-	2444
Channel Length (ft)							-	-	3064	-	-	330	-	-	4400	-	-	4400
Sinuosity							-	-	1.1	-	2.3	1.4	-	2.1	1.6	-	-	1.8
Water Surface Slope							-	-	-	-	-	-	-	-	7E-04	-	-	0.0011
BF Slope							-	-	-	-	-	-	-	-	-	-	-	0.0015
Rosgen Classification							G5c	G4	G5c	E5	C5	E5	E	C	E	-	-	C5
*Habitat Index																		
*Macrobenthos																		

*Inclusion will be project specific and determined primarily by As-built monitoring plan/success criteria

Exhibit Table VIII-A. Morphology and Hydraulic Monitoring Summary
Overhills Stream Mitigation Site/Project No. 199
Overhills - Upper Reach

Parameter	Cross Section 1			Cross Section 2			Cross Section 3			Cross Section 4			Cross Section 5			Cross Section 6		
	Sta 1+64 Pool			Sta 8+47 Pool			Sta 13+12 Riffle			Sta 20+93 Riffle			Sta 26+86 Pool			Sta 31+56 Riffle		
Dimension	MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2
BF Width (ft)	26.87	24.66	24.42	22.27	22.29	22.4	18.15	18.36	18.94	23.19	22.25	23.11	24.16	24.5	24.63	19.06	19.24	19.23
Floodprone Width (ft) (approx)	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100
BF Cross Sectional Area (ft^2)	71.89	67.45	67.39	44.82	51.12	54.18	31.03	31.52	35.19	49.19	59.6	64.86	37.7	40.91	44.36	23.43	25.35	25.4
BF Mean Depth (ft)	2.74	2.68	2.76	2.01	2.29	2.42	1.71	1.76	1.86	2.12	2.68	2.81	1.56	1.67	1.86	1.23	1.32	1.31
BF Max Depth (ft)	4.5	4.66	4.8	4.8	4.90	4.8	2.6	2.6	3.0	4.3	5.9	5.6	2.4	2.6	2.7	1.9	2.2	2.1
Width/Depth Ratio	9.0	10.0	8.9	11.1	9.7	9.3	10.6	10.7	10.2	10.9	8.3	8.2	15.5	14.7	13.7	15.5	14.6	14.7
Entrenchment Ratio	>3.72	>4.1	>4.1	>4.49	>4.48	>4.46	>5.51	>5.6	>5.3	>4.32	>4.49	>4.33	>4.14	>4.08	>4.06	>5.25	>5.20	>5.20
Bank Height Ratio			1.0			1.0			1.0			1.0			1.0			1.0
Wetted Perimeter (ft)			2.6			2.18			1.75			2.4			1.59			1.17
Hydraulic radius (ft)																		
Substrate							0.27	0.10	0.11	0.093	0.081	0.092				0.27	0.15	0.11
d50 (mm)							0.41	0.27	0.33	0.36	0.28	0.35				0.44	0.35	0.33
d84 (mm)																		

	MY-00 (2007)			MY-01 (2007)			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)		
Parameter	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern	48	149	100	42	146	94	45	152	96									
Channel Beltwidth (ft)	30	167	68.0	35	158	74	36	152	72									
Radius of Curvature (ft)	130	260	220	125	276	205	125	260	195									
Meander Wavelength (ft)	6.40	13.70	10.10	6.30	14.00	10.10	6.12	12.73	9.55									
Meander Width Ratio																		
Profile	20	122	72	20	100	60	22	112	65									
Riffle Length (ft)	0.0011	0.1630	0.0815	0.0016	0.1400	0.0710	0.0011	0.1100	0.0650									
Riffle Slope (ft)	8	116	51.0	14	37	84	10	45	90									
Pool Length (ft)	39	231	121	39	319	111	44	330	120									
Pool Spacing (ft)																		
Additional Reach Parameters	2605			2605			1950											
Valley Length (ft)	4400			4400			3310											
Channel Length (ft)	1.68			2			1.70											
Sinousity	0.0016			0.0015			0.0015											
Water Surface Slope (ft/ft)	0.0012			0.0011			0.0011											
BF Slope (ft/ft)	C			C			C5											
Rosgen Classification																		
*Habitat Index																		
*Macrobenthos																		

Exhibit Table VIII - B. Morphology and Hydraulic Monitoring Summary
Overhills Stream Mitigation Site/Project No. 199
Overhills - Lower Reach

Parameter	Cross Section 7[†]			Cross Section 8			Cross Section 9[₮]											
	Sta 37+24 Riffle			Sta 43+82 Pool			Sta 39+29 Riffle											
Dimension	MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2									
BF Width (ft)	16.54	16.68	16.68	27.1	27.72	27.69			26.71									
Floodprone Width (ft) (approx)	>100	>100	>100	>100	>100	>100			>100									
BF Cross Sectional Area (ft^2)	35.21	39.41	40.8	106.1	110.97	113.53			62.93									
BF Mean Depth (ft)	2.13	2.36	2.45	3.92	4	4.1			2.36									
BF Max Depth (ft)	3.5	3.7	4.2	7.4	7.1	6.9			5.0									
Width/Depth Ratio	7.8	7.1	6.8	6.9	6.9	6.8			11.3									
Entrenchment Ratio	>6.05	>6.0	>6	>3.69	>3.61	>3.61			>3.75									
Bank Height Ratio			1.0			1.0			1.0									
Wetted Perimeter (ft)			20.18			32.59			29.5									
Hydraulic radius (ft)			2.29			3.49			2.13									
Substrate																		
d50 (mm)									0.12									
d84 (mm)									0.35									

Parameter	MY-00 (2007)			MY-01 (2007)			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)							66	130	94									
Radius of Curvature (ft)							39	150	85									
Meander Wavelength (ft)							126	352	190									
Meander Width Ratio							4.72	13.18	7.13									
Profile																		
Riffle Length (ft)							20	46	32									
Riffle Slope (ft)							0.0021	0.0128	0.0077									
Pool Length (ft)							20	50	30									
Pool Spacing (ft)							29	102	57									
Additional Reach Parameters																		
Valley Length (ft)								929										
Channel Length (ft)								1171										
Sinousity								1.3										
Water Surface Slope (ft/ft)								0.0033										
BF Slope (ft/ft)								0.0012										
Rosgen Classification								E5										
*Habitat Index																		
*Macrobenthos																		

*Inclusion will be project specific and determined primarily by As-built monitoring plan/success criteria

[T]Cross Section 9 added in Year 2 to provide sufficient cross-sectional data for the Lower Reach as requested by NCEEP

2.3 WETLAND ASSESSMENT

2.3.1 Wetland Criteria Attainment

A site is considered to meet the requirements for wetland hydrology if the groundwater saturation is within 12 inches of the ground surface consecutively for 12.5% of the growing season. Fifteen groundwater monitoring wells are currently active on the project site. All 15 wells met the success criteria during the growing season of 2008 (Appendix C). The growing season in this area is from March 18th to November 8th for a total of 234 days (NRCS 2002).

A reference well was installed in the vicinity of the site on October 2, 2007. This site served as the reference site for the overstory vegetation and the wetland restoration. The site is a Coastal Plain Small Stream Swamp located along Muddy Creek, west of Overhills Lake. Data was collected from October 2 until the present (Figure 1). Refer to the Overhills Stream and Wetland Restoration Plan for more specific details on the physical and biological characteristics of the reference site. The reference well met the success criteria, with a maximum of 71 consecutive days of saturation within 12 inches of the ground surface. Precipitation this year fell between the 30th and 70th percentiles for all months during the growing season except March, June and October which fell just below the 30th percentile. April and September precipitation fell well above the 70th percentile.

Exhibit Table IX. Wetland Criteria Attainment
Overhills/Jumping Run Creek Restoration Project / EEP Project No. 199

Tract	Well ID	Well Hydrology Threshold Met?	Tract Mean		Vegetation Plot ID	Vegetation Density Met (320 stems/acre)	Tract Mean
Site	1	Y	100%		VP1	Y (405)	70% (421 stems/acre)
	2	Y			VP2	N (162)	
	3	Y			VP3	N (243)	
	4	Y			VP4	Y (364)	
	5	Y			VP5	N (121)	
	6	Y			VP6	Y (1093)	
	7	Y			VP7	Y (364)	
	8	Y			VP8	Y (688)	
	9	Y			VP9	Y (324)	
	10	Y			VP10	Y (445)	
	11	Y					
	12	Y					
	13	Y					
	14	Y					
	15	Y					
Reference	Ref Site 1	Y	100%				

2.3.2 Current Condition Plan View

The plan view for the wetland problem areas is located in the Integrated Current Condition Plan View in Appendix D.

3.0 References

Harrelson, C.C., C.L. Rawlins and J.P. Potyondy. 1994. Stream Channel Reference Sites: An Illustrated Guide to Field Technique. United States Department of Agriculture, Fort Collins, CO.

Lee, Michael T., R. K. Peet, S. D. Roberts, and T. R. Wentworth. 2006. CVS-EEP Protocol for Recording Vegetation, Version 4.0 (http://cvs.bio.unc.edu/methods.htm).

NC CRONOS. 2008. NC CRONOS Database – Dunn 4 NW (312500). North Carolina State University. State Climate Office of North Carolina. http://www.nc-climate.ncsu.edu/cronos.

NCEEP. 2006. Content, Format and Data Requirements for EEP Monitoring Reports. North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program. Raleigh, NC. Version 1.2 November 16, 2006.

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, CO.

USACE. 2003. Stream Mitigation Guidelines. United States Army Corps of Engineers, Wilmington Regulatory District; North Carolina Division of Water Quality; United Stated Environmental Protection Agency, Region IV; Natural Resources Conservation Service; and North Carolina Wildlife Resources Commission. April 2003.

Weakley, Alan S. 2007. Flora of the Carolinas, Virginia, Georgia, and surrounding areas. University of North Carolina Herbarium. Chapel Hill, NC. Working draft of January 11, 2007.

Appendix A. Vegetation Raw Data

A.1 VEGETATION DATA TABLES

EXHIBIT TABLE A1. VEGETATION METADATA

Report Prepared By	Kristin Weidner
Date Prepared	10/27/2008 10:18
Database Name	Stantec-Overhills_MillBranch-2008-B-v226-yr0-yr1-yr2_.mdb
Database Location	U:\171300168\CVS_databases\Overhills_MillBranch
Computer Name	WEIDNERK-SP1
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT	
Metadata	This worksheet, which is a summary of the project and the project data.
Proj, planted	Each project is listed with its PLANTED stems, for each year. This excludes live stakes and lists stems per acre.
Proj, total stems	Each project is listed with its TOTAL stems, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems. Listed in stems per acre.
Plots	List of plots surveyed.
Vigor	Frequency distribution of vigor classes.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
ALL Stems by Plot and spp	Count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY	
Metadata	Peet, R.K., T.R. Wentworth, M. P. Schafale & A.S. Weakley. 2004. Carolina Vegetation Survey database. Version 3.0. North Carolina Botanical Garden. Chapel Hill, NC 27599
Project Code	199
Project Name	Overhills Stream and Wetland Restoration
Description	Stream and Wetland Restoration
River Basin	Cape Fear
Length(ft)	4482
Stream-to-edge width (ft)	500
Area (sq m)	0.1
Required Plots (calculated)	NA
Sampled Plots	10

EXHIBIT TABLE A2. VEGETATION VIGOR BY SPECIES

	Species	4	3	2	1	0	Missing
	Cephalanthus occidentalis	5	4	1	1		
	Cornus amomum	4	4	3		1	
	Cyrilla racemiflora		1				
	Fraxinus pennsylvanica	7					
	Nyssa biflora	8	15				3
	Quercus nigra	1					
	Quercus phellos	2					1
	Salix nigra		5		1		
	Sambucus canadensis	1	2	5		3	1
	Sambucus nigra	1					
	Taxodium distichum	21	6				
	Morella cerifera	2					
	Magnolia grandiflora	2					1
	Unknown	2					
TOT:	**14**	**56**	**37**	**9**	**2**	**4**	**6**

EXHIBIT TABLE A3. VEGETATION DAMAGE BY SPECIES

	Species	All Damage Categories	No Damage	Flood	Site Too Wet	Unknown
	Cephalanthus occidentalis	11	9	1	1	
	Cornus amomum	13	12			1
	Cyrilla racemiflora	1	1			
	Fraxinus pennsylvanica	7	7			
	Magnolia grandiflora	3	3			
	Morella cerifera	2	2			
	Nyssa biflora	27	27			
	Quercus nigra	1	1			
	Quercus phellos	4	4			
	Salix nigra	6	6			
	Sambucus canadensis	12	8	1	2	1
	Sambucus nigra	1	1			
	Taxodium distichum	27	27			
	Unknown	2	2			
TOT:	**14**	**117**	**110**	**2**	**3**	**2**

EXHIBIT TABLE A4. VEGETATION DAMAGE BY PLOT

	plot	All Damage Categories	No Damage	Flood	Site Too Wet	Unknown
	Overhills-01-0001-year:2	11	10	1		
	Overhills-01-0002-year:2	4	4			
	Overhills-01-0003-year:2	7	7			
	Overhills-01-0004-year:2	9	9			
	Overhills-01-0005-year:2	3	3			
	Overhills-01-0006-year:2	34	29		3	2
	Overhills-01-0007-year:2	11	11			
	Overhills-01-0008-year:2	19	18	1		
	Overhills-01-0009-year:2	8	8			
	Overhills-01-0010-year:2	11	11			
TOT:	**10**	**117**	**110**	**2**	**3**	**2**

EXHIBIT TABLE A5-A. STEM COUNT BY PLOT AND SPECIES - Year 2

	Species	Total Planted Stems	# plots	avg# stems	plot Overhills-01-0001-year:2	plot Overhills-01-0002-year:2	plot Overhills-01-0003-year:2	plot Overhills-01-0004-year:2	plot Overhills-01-0005-year:2	plot Overhills-01-0006-year:2	plot Overhills-01-0007-year:2	plot Overhills-01-0008-year:2	plot Overhills-01-0009-year:2	plot Overhills-01-0010-year:2
	Cephalanthus occidentalis	11	2	6	4					7				
	Cornus amomum	11	3	4	1					6		4		
	Cyrilla racemiflora	1	1	1	1									
	Fraxinus pennsylvanica	7	4	2			2	3			1		1	
	Magnolia grandiflora	2	1	2						2				
	Morella cerifera	2	2	1						1		1		
	Nyssa biflora	23	8	3	2		2	4	1		2	4	3	5
	Quercus nigra	1	1	1								1		
	Quercus phellos	2	1	2						2				
	Salix nigra	6	3	2	2					2		2		
	Sambucus canadensis	8	2	4						6		2		
	Sambucus nigra	1	1	1								1		
	Taxodium distichum	27	9	3		4	2	2	2	1	4	2	4	6
	Unknown	2	1	2							2			
TOT:	**14**	104	14		10	4	6	9	3	27	9	17	8	11
	Total Planted Stems/Acre				405	162	243	364	121	1093	364	688	324	445

EXHIBIT TABLE A5-A. STEM COUNT BY PLOT AND SPECIES - Year 1

	Species	Total Planted Stems	# plots	avg# stems	plot Overhills-01-0001-year:1	plot Overhills-01-0002-year:1	plot Overhills-01-0003-year:1	plot Overhills-01-0004-year:1	plot Overhills-01-0005-year:1	plot Overhills-01-0006-year:1	plot Overhills-01-0007-year:1	plot Overhills-01-0008-year:1	plot Overhills-01-0009-year:1	plot Overhills-01-0010-year:1
	Cephalanthus occidentalis	11	2	5.5	4					7				
	Cornus amomum	12	3	4	1					6		5		
	Cyrilla racemiflora	1	1	1	1									
	Fraxinus pennsylvanica	7	4	1.75			2	3			1		1	
	Magnolia grandiflora	2	1	2						2				
	Morella cerifera	2	2	1						1		1		
	Nyssa biflora	23	9	2.56	1		3	3	1	1	4	4	1	5
	Quercus nigra	1	1	1								1		
	Quercus phellos	4	2	2	1					3				
	Salix nigra	6	3	2	2					2		2		
	Sambucus canadensis	8	2	4						6		2		
	Sambucus nigra	1	1	1								1		
	Taxodium distichum	27	9	3		4	2	2	2	1	4	2	4	6
	Unknown	3	2	1.5							2		1	
TOT:	**14**	108	14		10	4	7	8	3	29	11	18	7	11
	Total Planted Stems/Acre				405	162	283	324	121	1174	445	728	283	445

EXHIBIT TABLE A6. VEGETATION PROBLEM AREAS

Feature/Issue	Station # / Range	Probable Cause	Photo #
Death of trees and plants	VPA1 & VPA2	Persistent flooding	1 & 2
Invasive/exotic species	VPA3	Invasion of *Lespedeza*	3

*The location of vegetation problem areas is show in the Integrated Current Condition Plan View map in Appendix D

A.2 VEGETATION PROBLEM AREA PHOTOS

Photo 1. Flooding in VPA-1 facing northeast. Ponding causing vegetation failure (11/07/2008).

Photo 2. Frequent ponding in VPA-2 causing lack of woody vegetation (11/07/2008).

Photo 3. Invasive species, *Lespedeza,* in VPA3 (11/07/2008).

A.3 VEGETATION MONITORING PLOT PHOTOS

Note: Due to a camera malfunction, plot photos were taken at a later date than vegetation sampling.

Photo Station 11. Veg Plot 1 – looking north (11/07/2008).

Photo Station 12. Veg Plot 1 – looking northeast (11/07/2008).

Photo Station 13. Veg Plot 2 – looking northeast (11/07/2008).

Photo Station 14. Veg Plot 2 – looking north (11/07/2008).

Photo Station 15. Veg Plot 3 – looking northeast (11/07/2008).

Photo Station 16. Veg Plot 3 – looking north (11/07/2008).

Photo Station 17. Veg Plot 4 – looking northeast (11/07/2008).

Photo Station 18. Veg Plot 4 – looking east (11/07/2008).

Photo Station 19. Veg Plot 5 – looking northeast (11/07/2008).

Photo Station 20. Veg Plot 5 – looking east (11/07/2008).

Photo Station 21. Veg Plot 6 – looking southwest (11/07/2008).

Photo Station 22. Veg Plot 6 – looking west (11/07/2008).

Photo Station 23. Veg Plot 7 – looking north (11/07/2008).

Photo Station 24. Veg Plot 7 – looking northeast (11/07/2008).

Photo Station 25. Veg Plot 8 – looking southwest (11/07/2008).

Photo Station 26. Veg Plot 8 – looking west (11/07/2008).

Photo Station 27. Veg Plot 9 – looking north (11/07/2008).

Photo Station 28. Veg Plot 9 – looking northeast (11/07/2008).

Photo Station 29. Veg Plot 10 – looking northwest (11/07/2008).

Photo Station 30. Veg Plot 10 – looking west (11/07/2008).

Appendix B. Geomorphologic Raw Data

B.1 PROBLEM AREA PLAN VIEW (STREAM)

Please see the Integrated Problem Area Plan View in Appendix D for stream problem areas.

B.2 STREAM PROBLEM AREAS TABLE

Overhills/Jumping run Creek Restoration Project - EEP No. 199					
MAJOR PROBLEM AREAS					
Feature/Issue	**Stream Reach**	**Station # / Range**	**Probable Cause**	**ID**	**Photo #**
Headcut	Lower reach	33+00	In-stream structural failure	SPA 1	1
Bank Erosion/Migration	Lower reach	33+00 to 44+00	Headcut formation, in-stream structural failure	SPA 1	1 &2
Mid-channel Bar Formation	Lower reach	33+00 to 44+00	In-stream structural failure	SPA 1	5
Scour/Sedimentation	Upper reach	6+30	Beaver dam	SPA 9	3
Scour/Sedimentation	Upper reach	23+15	Beaver dam	SPA 9	NA
Scour/Sedimentation	Upper reach	27+77	Beaver dam	SPA 9	NA
MINOR PROBLEM AREAS					
Bank Erosion/Bare Floodplain	Upper reach	0+00 to 32+00	Excess near bank shear stress	SPA 2-8	4

B.3 REPRESENTATIVE STREAM PROBLEM AREAS PHOTOS

Photo 1. Looking downstream at a severely eroded bank and failed structure (10/23/08).

Photo 2. Looking upstream at failed bank and structure, near headcut at Sta. 33+00 (10/23/08).

Photo 3. Beaver dam with scour on right bank (2/08/2008).

Photo 4. Bare floodplain and minor bank scour (10/23/2008).

Photo 5. Mid-channel bar formation at Cross section 6 (8/12/2008).

B.4 STREAM REPRESENTATIVE PHOTOS AND PHOTO STATION PHOTOS

Photo 1. Evidence of bankfull overflow near Vegetation Plot 3 (11/07/2008).

Photo 2. Typical example of the restored channel upstream of headcut area.

Photo Station 1. Beginning of Reach Cross section 1 – looking upstream (11/07/2008) (Note: Locations of stations are shown on the monitoring plan view).

Photo Station 2. Cross section 1 – looking downstream (8/12/2008).

Photo Station 3. Cross section 2 – looking downstream (8/12/2008).

Photo Station 4. Cross section 3 – looking downstream (8/12/2008).

Photo Station 5. Cross section 4 – looking downstream (8/12/2008).

Photo Station 6. Cross section 5 – looking downstream (8/12/2008).

Photo Station 7. Cross section 6 – looking downstream (8/12/2008).

Photo Station 8. Cross section 7 – looking downstream (8/12/2008).

Photo Station 9. Cross section 8 – looking downstream (8/12/2008).

Photo Station 10. End of Project – Cross section 8 - looking upstream (8/12/2008).

Photo Station 31. Cross-section 9 looking downstream (8/12/08).

Photo Station 32. Cross section 9 looking upstream (8/12/08).

B.5 QUALITATIVE VISUAL STABILITY ASSESSMENT

Exhibit Table B.2A. Visual Morphological Stability Assessment Overhills/Jumping Run Creek Upper Reach - EEP Project No. 199						
Feature Category	**Metric (per As-built and reference baselines)**	**(# Stable) Number Performing as Intended**	**Total Number per As-built**	**Total Number/Feet in Unstable State**	**% Perform in Stable Condition**	**Feature Perform. Mean or Total**
A. Riffles	1. Present?	14	14		100%	
	2. Armor stable (eg no displacement?)	N/A	N/A			
	3. Facet grade appears stable?	14	14		100%	
	4. Minimal evidence of embedding/fining?	N/A	N/A			
	5. Length appropiate?	14	14		100%	100%
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	14	14		100%	
	2. Sufficiently deep (Max Pool D:Mean Bkf > 1.6?)	14	14		100%	
	3. Length appropriate?	12	14		86%	95%
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	16	16		100%	
	2. Downstream of meander (glide/inflection) centering?	16	16		100%	100%
D. Meanders	1. Outer bend in state of limited/controlled erosion?	23	23		100%	
	2. Of those eroding, # w/concomitant point bar formation?	0	0		100%	
	3. Apparent Rc within spec?	23	23		100%	
	4. Sufficient floodplain access and relief?	23	23		100%	100%
E. Bed General	1. General channel bed aggradation areas (bar formation)		3200	100	97%	
	2. Channel bed degradation - areas of increasing down-cutting or head-cutting?		3200	100	97%	97%
F. Bank	1. Actively eroding, wasting, or slumping bank?		3200	100	97%	97%
G. Vanes	1. Free of back or arm scour?	12	15		80%	
	2. Height appropriate?	12	15		80%	
	3. Angle and geometry appear appropriate?	10	15		67%	
	4. Free of piping or other structural failures?	12	15		80%	77%
H. Wads/Boulders	1. Free of scour?	n/a	n/a		n/a	n/a
	2. Footing stable?	n/a	n/a		n/a	n/a

Exhibit Table B.2B. Visual Morphological Stability Assessment Overhills/Jumping Run Creek Lower Reach - EEP Project No. 199						
Feature Category	**Metric (per As-built and reference baselines)**	**(# Stable) Number Performing as Intended**	**Total Number per As-built**	**Total Number/Feet in Unstable State**	**% Perform in Stable Condition**	**Feature Perform. Mean or Total**
A. Riffles	1. Present?	1	7		14%	
	2. Armor stable (eg no displacement?)	N/A	N/A			
	3. Facet grade appears stable?	1	7		14%	
	4. Minimal evidence of embedding/fining?	N/A	N/A			
	5. Length appropiate?	4	7		57%	29%
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	5	8		63%	
	2. Sufficiently deep (Max Pool D:Mean Bkf > 1.6?)	6	8		75%	
	3. Length appropriate?	1	8		13%	50%
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	0	6		0%	
	2. Downstream of meander (glide/inflection) centering?	0	6		0%	0%
D. Meanders	1. Outer bend in state of limited/controlled erosion?	0	9		0%	
	2. Of those eroding, # w/concomitant point bar formation?	3	9		33%	
	3. Apparent Rc within spec?	9	9		100%	
	4. Sufficient floodplain access and relief?	5	9		56%	47%
E. Bed General	1. General channel bed aggradation areas (bar formation)		1200	100	92%	
	2. Channel bed degradation - areas of increasing down-cutting or head-cutting?		1200	1110	8%	50%
F. Bank	1. Actively eroding, wasting, or slumping bank?		1200	1200	0%	0%
G. Vanes	1. Free of back or arm scour?	0	22		0%	
	2. Height appropriate?	0	22		0%	
	3. Angle and geometry appear appropriate?	0	22		0%	
	4. Free of piping or other structural failures?	0	22		0%	0%
H. Wads/Boulders	1. Free of scour?	n/a	n/a		n/a	n/a
	2. Footing stable?	n/a	n/a		n/a	n/a

B.6 CROSS SECTION PLOTS

See following page for cross section plots.

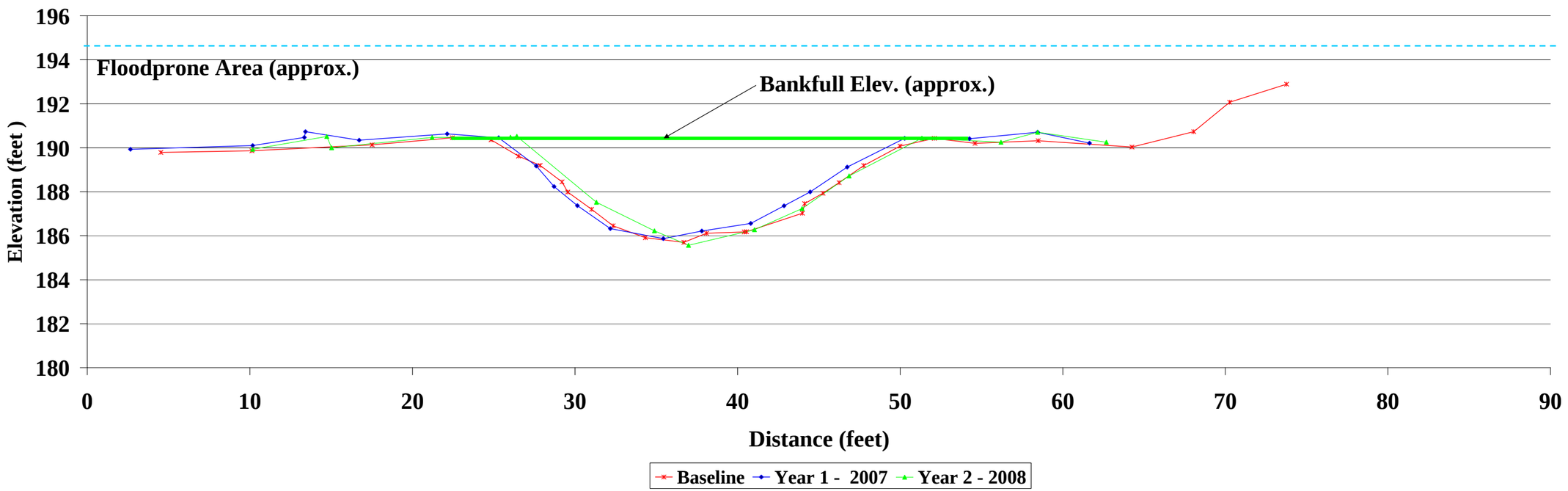
Project Name	Overhills
Cross Section	Cross Section 1
Feature	Pool
Date	As Built - 07/04/08, Year 1 - 11/09/08, Year 2 - 08/12/08
Crew	As Built - Bidelspach, Jean, Geenen, Year 1&2 - Geenen, Ballestero

Year 5 - 2011 2011 Survey			Year 4 - 2010 2010 Survey			Year 3 - 2009 2009 Survey			Year 2 - 2008 2008 Survey			Year 1 - 2007 2007 Survey			Baseline Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
									10.17	189.93	Left Pin	2.65	189.93	Left Pin	4.52	189.79	Left Pin
									14.73	190.51		10.17	190.1		10.13	189.86	
									15.03	190		13.35	190.47		17.52	190.13	
									21.21	190.47	0	13.42	190.73		22.45	190.45	
									26.03	190.48	0 LBK	16.72	190.34		24.83	190.36	LBK
									26.42	190.52	5.43901	22.13	190.63		26.52	189.62	1.404279
									31.32	187.52	3.789934	25.3	190.45	2.455238 LBK	27.86	189.2	1.535611
									34.88	186.22	2.201272	27.61	189.17	1.440451	29.2	188.45	0.586003
									36.98	185.56	4.111764	28.71	188.24	1.682409	29.55	187.98	1.664121
									41.03	186.27	3.083261	30.15	187.37	2.276598	31.02	187.2	1.51819
									43.96	187.23	3.260383	32.17	186.32	3.290912	32.34	186.45	2.052316
									46.86	188.72	4.566732	35.43	185.87	2.394264	34.32	185.91	2.379286
									51.33	190.44	RBK	37.8	186.21	3.030281	36.69	185.7	1.458801
									56.2	190.25		40.81	186.56	2.200568	38.09	186.11	2.320776
									58.46	190.71	Right Pin	42.86	187.36	1.728872	40.41	186.17	0.130384
									62.68	190.25		44.47	187.99	2.535705	40.54	186.18	3.550789
												46.74	189.12	3.572916	43.99	187.02	0.458803
												50.28	190.43	0 RBK	44.12	187.46	1.223846
												54.26	190.41		45.25	187.93	1.100227
												58.46	190.71	Right Pin	46.24	188.41	1.70845
												61.65	190.21		47.76	189.19	2.397353
															49.99	190.07	1.724284
															52.1	190.43	RBK
															54.6	190.2	
															58.49	190.32	Right Pin
															64.25	190.03	
															68.06	190.73	
															70.27	192.07	
															73.77	192.89	

Photo of Cross-Section 1 - Looking Downstream @ STA 1+64

	Year 5 - 2011	Year 4 - 2010	Year 3 - 2009	Year 2 - 2008	Year 1 - 2007	Baseline	Bench
Area				67.39	67.45	71.89	
Width				24.42	24.66	26.87	
Mean Depth				2.76	2.74	2.68	
Max Depth				4.80	4.49	4.66	
W/D				8.85	9.02	10.04	
Wetted				26.4523561	26.60821381	27.21351782	
HR				2.547551738	2.535021456	2.641721503	

Overhills
Cross Section #1 (Pool)



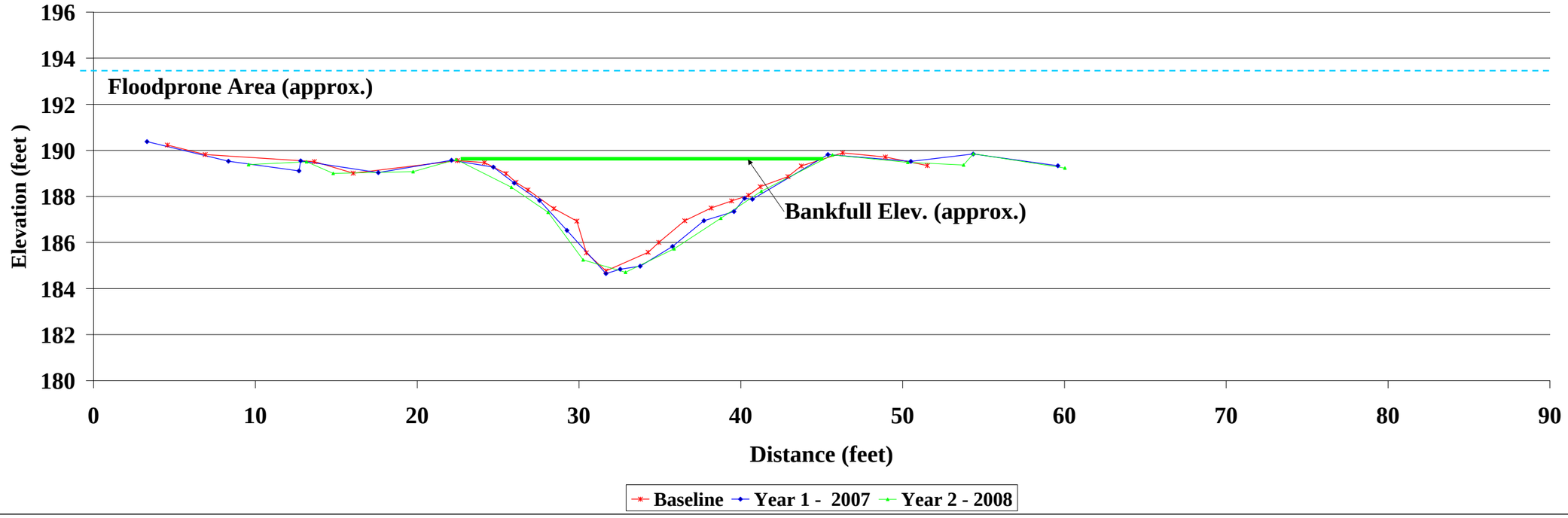
Project Name	Overhills
Cross Section	Cross Section 2
Feature	Pool
Date	As Built - 07/04/08, Year 1 - 11/09/08, Year 2 - 08/12/08
Crew	As Built - Bidelspach, Jean, Geenen, Year 1&2 - Geenen, Ballestero

Year 5 - 2011 2011 Survey			Year 4 - 2010 2010 Survey			Year 3 - 2009 2009 Survey			Year 2 - 2008 2008 Survey				Year 1 - 2007 2007 Survey				Baseline Survey			
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**		**Notes**	**Station**	**Elevation**		**Notes**	**Station**	**Elevation**		**Notes**
									9.58	189.38			3.3	190.38			4.56	190.23		
									13.16	189.5		Left Pin	8.33	189.53			6.9	189.82		
									14.81	189			12.7	189.11			13.65	189.51		Left Pin
									19.75	189.07			12.8	189.54		Left Pin	16.04	189.01		
									22.42	189.6	3.45532	LBK	17.6	189.03			22.49	189.55	1.671915	LBK
									25.82	188.4	2.518134		22.12	189.57	2.433496	LBK	24.16	189.47	1.413966	
									28.09	187.31	2.998966		24.71	189.27	1.462942		25.49	188.99	0.718679	
									30.26	185.24	2.663269		26	188.58	1.735281		26.1	188.61	0.81939	
									32.87	184.71	3.165454		27.56	187.82	2.140093		26.85	188.28	1.784433	
									35.87	185.72	3.181352		29.26	186.52	3.05041		28.44	187.47	1.528561	
									38.76	187.05	2.769296		31.67	184.65	0.900278		29.87	186.93	1.49693	
									41.27	188.22	3.927433		32.55	184.84	1.236851		30.45	185.55	1.445061	
									45.66	189.8		RBK	33.78	184.97	2.177062		31.66	184.76	2.742353	
									50.32	189.48			35.78	185.83	2.235106		34.28	185.57	0.779359	
									53.76	189.36			37.72	186.94	1.892749		34.93	186	1.855694	
									54.37	189.85		Right Pin	39.57	187.34	0.878635		36.53	186.94	1.723514	
									60.03	189.23			40.23	187.92	0.49163		38.16	187.5	1.304952	
													40.72	187.88	4.345179		39.43	187.8	1.079352	
													45.38	189.82		RBK	40.48	188.05	0.809506	
													50.51	189.52			41.2	188.42	1.765701	
													54.36	189.84		Right Pin	42.91	188.86	0.948947	
													59.59	189.33			43.74	189.32	1.05434	
																	46.29	189.89		RBK
																	48.93	189.71		
																	51.53	189.34		
																	54.39	189.81		Right Pin
																	57.19	189.28		
																	62.87	189.3		

Photo of Cross-Section 2 - Looking Downstream @ STA 8+47

	Year 5 - 2011	Year 4 - 2010	Year 3 - 2009	Year 2 - 2008	Year 1 - 2007	Baseline	Bench
Area				54.18	51.12	44.82	
Width				22.40	22.29	22.27	
Mean Depth				2.42	2.29	2.01	
Max Depth				4.83	4.90	4.79	
W/D				9.26	9.72	11.07	
Wetted				24.67922456	24.97971226	24.94265233	
HR				2.19555032	2.04630597	1.797084443	

Overhills
Cross Section #2 (Pool)

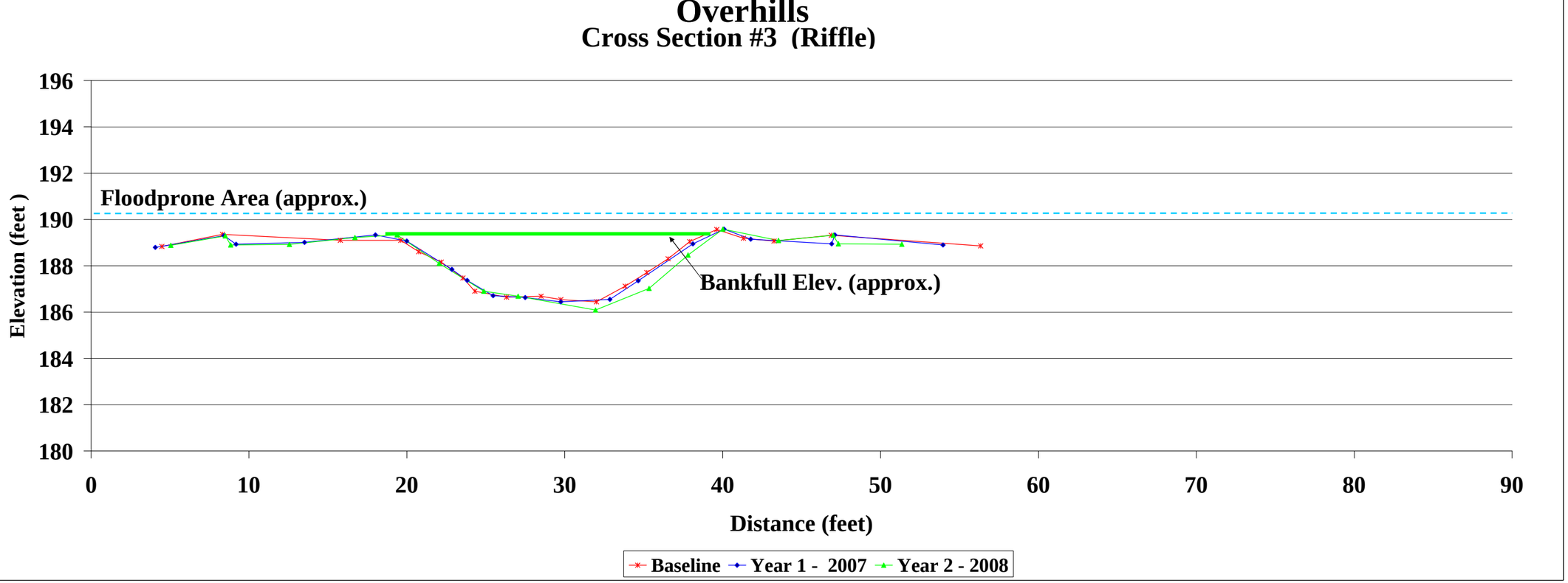


Project Name	Overhills
Cross Section	Cross Section 3
Feature	Riffle
Date	As Built - 07/04/08, Year 1 - 11/09/08, Year 2 - 08/12/08
Crew	As Built - Bidelspach, Jean, Geenen, Year 1&2 - Geenen, Ballestero

Year 5 - 2011 2011 Survey			Year 4 - 2010 2010 Survey			Year 3 - 2009 2009 Survey			Year 2 - 2008 2008 Survey			Year 1 - 2007 2007 Survey			Baseline Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
									5.05	188.88		4.06	188.79		4.48	188.83	
									8.5	189.29	Left Pin	8.41	189.3	Left Pin	8.32	189.36	Left Pin
									8.84	188.9		9.18	188.93		15.78	189.1	
									12.56	188.92		13.52	189.01		19.61	189.1	1.080849
									16.71	189.22	0 LBK	18	189.33	0	20.74	188.61	1.508675 LBK
									19.38	189.33	2.239656	19.99	189.07	3.037344 LBK	22.18	188.16	1.525025
									22.04	188.1	3.073906	22.85	187.84	1.077868	23.54	187.47	0.95
									24.87	186.9	2.181124	23.82	187.37	1.767824	24.3	186.9	2.026746
									27.04	186.68	4.935393	25.46	186.71	2.031576	26.31	186.64	2.180367
									31.94	186.09	3.524897	27.49	186.63	2.267973	28.49	186.68	1.267754
									35.34	187.02	2.850474	29.75	186.44	3.101951	29.75	186.54	2.262211
									37.8	188.46	1.287664	32.85	186.55	1.969772	32.01	186.44	1.93352
									40.02	189.58	0	34.65	187.35	3.812034	33.82	187.12	1.491643
									43.54	189.09	0 RBK	38.11	188.95	0.295469	35.19	187.71	1.473296
									47	189.32	Right Pin	40.08	189.58	0	36.54	188.3	1.557081
									47.33	188.95		41.78	189.15	RBK	37.91	189.04	0 RBK
									51.35	188.93		46.9	188.95		39.63	189.57	0
												47.1	189.33	Right Pin	41.31	189.19	0
												53.96	188.9		43.25	189.07	0
															46.88	189.32	Right Pin
															56.34	188.86	

Photo of Cross-Section 3 - Looking Downstream @ STA 13+12

	Year 5 - 2011	Year 4 - 2010	Year 3 - 2009	Year 2 - 2008	Year 1 - 2007	Baseline	Bench
Area				35.19	31.56	31.03	
Width				18.94	18.36	18.15	
Mean Depth				1.86	1.72	1.71	
Max Depth				2.95	2.60	2.60	
W/D				10.19	10.68	10.62	
Wetted				20.09311375	19.36180992	19.25716691	
HR				1.751142511	1.630124271	1.611285891	



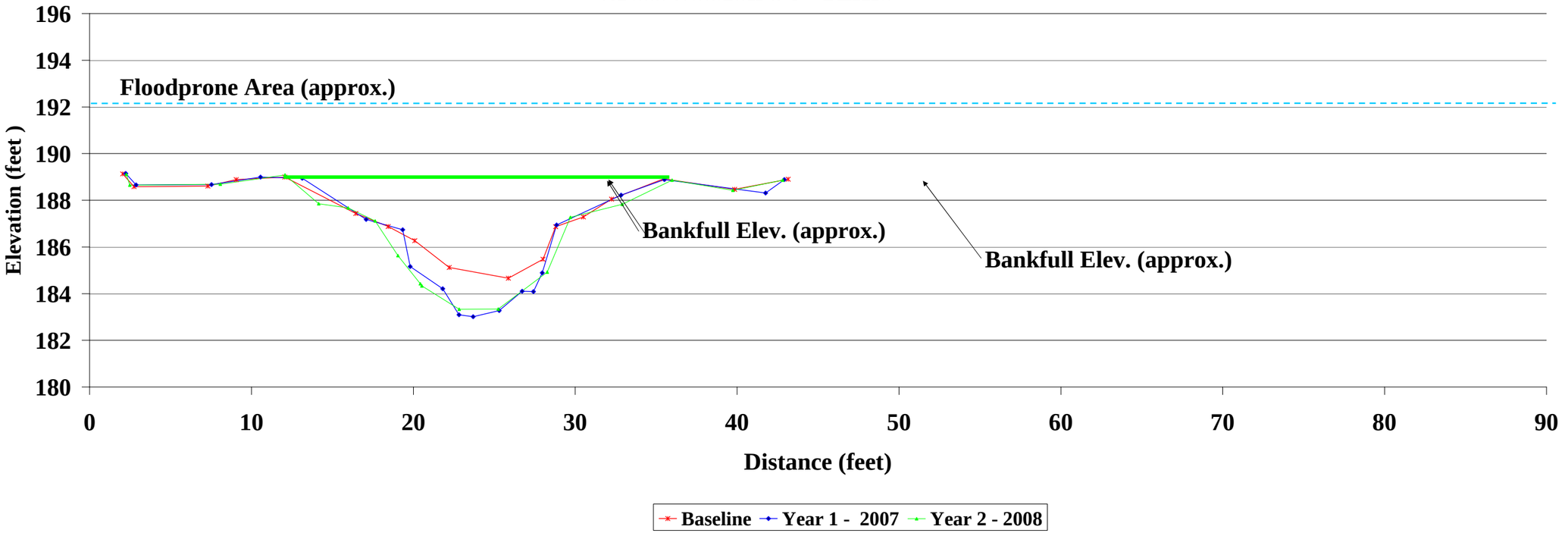
Project Name	Overhills
Cross Section	Cross Section 4
Feature	Riffle
Date	As Built - 07/04/08, Year 1 - 11/09/08, Year 2 - 08/12/08
Crew	As Built - Bidelspach, Jean, Geenen, Year 1&2 - Geenen, Ballestero

Year 5 - 2011 2011 Survey			Year 4 - 2010 2010 Survey			Year 3 - 2009 2009 Survey			Year 2 - 2008 2008 Survey			Year 1 - 2007 2007 Survey			Baseline Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
									2.27	189.11	Left Pin	2.24	189.15	Left Pin	2.04	189.13	Left Pin
									2.48	188.65		2.87	188.66		2.74	188.58	
									8.08	188.69	2.364291	7.53	188.67		7.31	188.61	
									12.07	189.08	2.102128 LBK	10.56	188.99	0 LBK	9.06	188.89	
									14.15	187.85	1.828879	13.14	188.94	4.266192	12.06	188.99	4.449883 LBK
									15.97	187.67	1.761391	17.08	187.18	2.302433	16.45	187.43	2.074247
									17.64	187.11	2.044138	19.34	186.74	1.648423	18.45	186.88	1.749771
									19.05	185.63	1.835347	19.81	185.16	2.223196	20.09	186.27	2.42062
									20.43	184.42	0.127279	21.82	184.21	1.501466	22.22	185.12	3.678872
									20.52	184.33	2.517161	22.82	183.09	0.87367	25.87	184.66	2.288165
									22.83	183.33	2.410021	23.69	183.01	1.630859	28.01	185.47	1.602623
									25.24	183.34	3.417206	25.3	183.27	1.64478	28.79	186.87	1.760824
									28.27	184.92	2.750891	26.72	184.1	0.700071	30.5	187.29	1.898736
									29.7	187.27	3.258481	27.42	184.09	0.965194	32.24	188.05	3.335461
									32.91	187.83	3.238179	27.96	184.89	2.23486	35.46	188.92	4.413004 RBK
									35.98	188.86	3.784508 RBK	28.85	186.94	4.180765	39.85	188.47	
									39.74	188.43		32.83	188.22	2.762481	43.15	188.9	Right Pin
									42.81	188.86	Right Pin	35.51	188.89	6.276854 RBK			
												41.76	188.31				
												42.92	188.89	Right Pin			

Photo of Cross-Section 4 - Looking Upstream @ STA 20+93

	Year 5 - 2011	Year 4 - 2010	Year 3 - 2009	Year 2 - 2008	Year 1 - 2007	Baseline	Bench
Area				64.86	59.60	49.19	
Width				23.11	22.25	23.19	
Mean Depth				2.81	2.68	2.12	
Max Depth				5.59	5.91	4.26	
W/D				8.23	8.31	10.93	
Wetted				33.43990054	33.21124613	29.67220553	
HR				1.939743639	1.794456744	1.657946369	

Overhills
Cross Section #4 (Riffle)



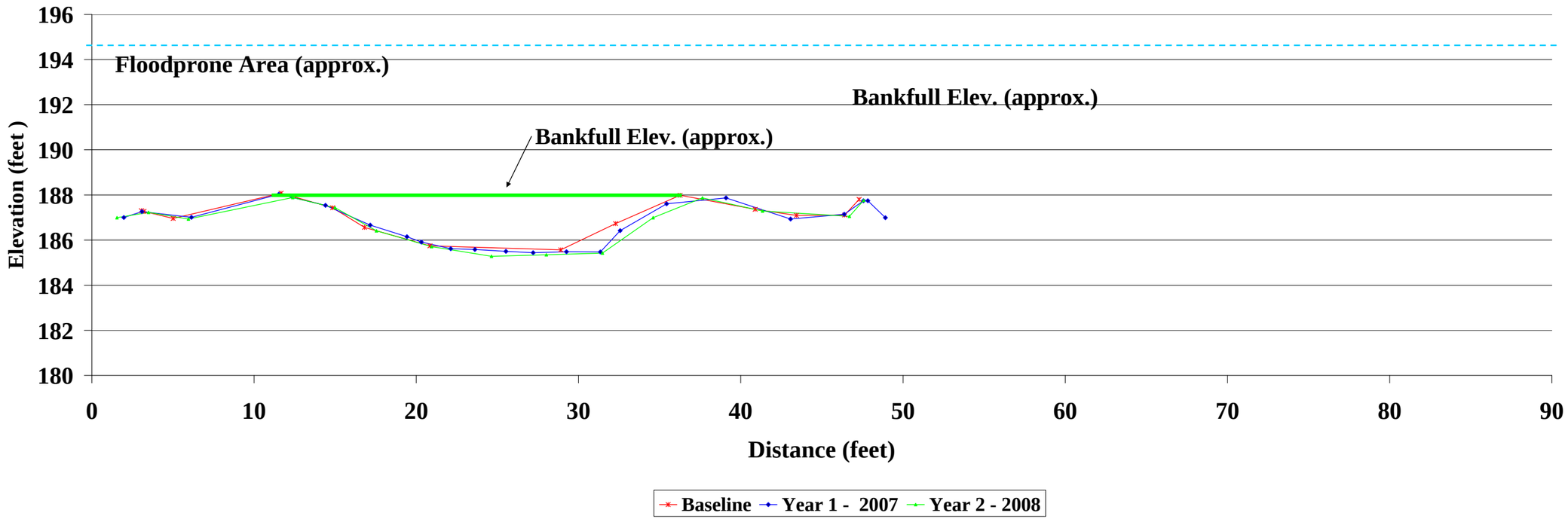
Project Name	Overhills
Cross Section	Cross Section 5
Feature	Riffle
Date	As Built - 07/04/08, Year 1 - 11/09/08, Year 2 - 08/12/08
Crew	As Built - Bidelspach, Jean, Geenen, Year 1&2 - Geenen, Ballestero

Year 5 - 2011 2011 Survey			Year 4 - 2010 2010 Survey			Year 3 - 2009 2009 Survey			Year 2 - 2008 2008 Survey				Year 1 - 2007 2007 Survey				Baseline Survey			
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**		**Notes**	**Station**	**Elevation**		**Notes**	**Station**	**Elevation**		**Notes**
									1.55	186.99			1.97	187			3.05	187.3		Left Pin
									3.5	187.23		Left Pin	3.09	187.26		Left Pin	3.21	187.27		
									5.95	186.93			6.14	187.01			5.01	186.96		
									12.38	187.89	2.660075	LBK	11.52	188.03		LBK	11.66	188.08	2.796339	LBK
									15	187.43	2.746434		14.4	187.54	2.896895		14.84	187.43	2.144411	
									17.55	186.41	3.471311		17.16	186.66	2.31683		16.8	186.56	4.122378	
									20.95	185.71	3.705037		19.42	186.15	0.93145		20.84	185.74	8.07179	
									24.63	185.28	3.380725		20.32	185.91	1.823211		28.91	185.57	3.564057	
									28.01	185.35	3.470706		22.12	185.62	1.490537		32.28	186.73	4.174686	
									31.48	185.42	3.49275		23.61	185.58	1.921666		36.26	187.99	4.672665	RBK
									34.6	186.99	3.164806		25.53	185.5	1.671077		40.89	187.36		
									37.64	187.87	3.745184	RBK	27.2	185.44	2.060388		43.43	187.09		
									41.34	187.29			29.26	185.48	2.080024		46.4	187.11		Right Pin
									46.7	187.05		Right Pin	31.34	185.47	1.554156		47.3	187.8		
									47.58	187.76			32.57	186.42	3.097693					
													35.43	187.61	3.669223					
													39.09	187.87	4.089499	RBK				
													43.07	186.93						
													46.38	187.14		Right Pin				
													47.57	187.74						
													47.83	187.74						
													48.91	186.99						

Photo of Cross-Section 5 - Looking Downstream @ STA 26+86

	Year 5 - 2011	Year 4 - 2010	Year 3 - 2009	Year 2 - 2008	Year 1 - 2007	Baseline	Bench
Area				44.36	40.91	37.70	
Width				24.63	24.50	24.16	
Mean Depth				1.80	1.67	1.56	
Max Depth				2.71	2.55	2.42	
W/D				13.67	14.68	15.48	
Wetted				29.83702777	29.60264967	29.54632655	
HR				1.486678266	1.381840516	1.276045597	

Overhills
Cross Section #5 (Riffle)



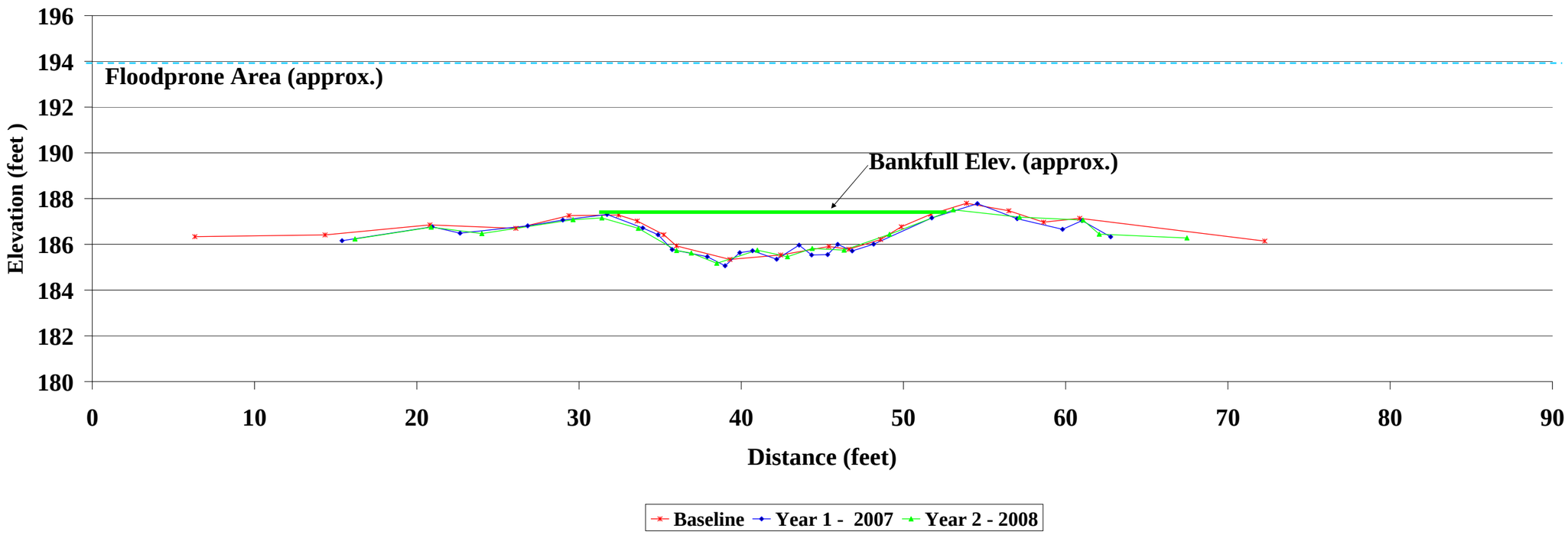
Project Name	Overhills
Cross Section	Cross Section 6
Feature	Pool
Date	As Built - 07/04/08, Year 1 - 11/09/08, Year 2 - 08/12/08
Crew	As Built - Bidelspach, Jean, Geenen, Year 1&2 - Geenen, Ballestero

Year 5 - 2011 2011 Survey			Year 4 - 2010 2010 Survey			Year 3 - 2009 2009 Survey			Year 2 - 2008 2008 Survey			Year 1 - 2007 2007 Survey			Baseline Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
									16.19	186.24	0	15.39	186.16	0	6.32	186.34	0
									20.88	186.75	0 Left Pin	20.95	186.77	0 Left Pin	14.35	186.41	0
									24.02	186.47	0	22.67	186.49	0	20.81	186.85	0 Left Pin
									29.63	187.08	0	26.84	186.81	0	26.11	186.7	0
									31.41	187.16	2.296541 LBK	29	187.06	0	29.39	187.26	0
									33.66	186.7	2.551568	31.73	187.31	0 LBK	32.45	187.28	1.169273 LBK
									36.02	185.73	0.906697	33.93	186.72	0.986712	33.59	187.02	1.74631
									36.92	185.62	1.633218	34.87	186.42	1.086002	35.23	186.42	0.921141
									38.49	185.17	2.566398	35.74	185.77	2.192031	36.01	185.93	3.342484
									40.99	185.75	1.882472	37.91	185.46	1.17047	39.3	185.34	3.146363
									42.85	185.46	1.56205	39.01	185.06	1.070701	42.44	185.54	2.983035
									44.37	185.82	1.971243	39.91	185.64	0.784092	45.4	185.91	1.245793
									46.34	185.75	2.883765	40.69	185.72	1.535252	46.64	185.79	1.994718
									49.14	186.44	3.197541	42.18	185.35	1.512878	48.59	186.21	1.387984
									53.07	187.51	1.151024 RBK	43.56	185.97	0.890674	49.86	186.77	1.771892
									57.15	187.19	0	44.34	185.54	0.990051	51.69	187.32	0 RBK
									61.07	187.06	0 Right Pin	45.33	185.55	0.766094	53.89	187.8	0
									62.07	186.45	0	45.95	186	0.936056	56.5	187.47	0
									67.47	186.28	0	46.84	185.71	1.353662	58.64	186.97	0
												48.16	186.01	3.769695	60.87	187.14	0 Right Pin
												51.75	187.16	0.556952 RBK	72.27	186.14	0
												54.56	187.78	0			
												57.01	187.12	0			
												59.8	186.66	0			
												61.01	187.04	0 Right Pin			
												62.77	186.33	0			

Photo of Cross-Section 6 - Looking Downstream @ STA 31+56

	Year 5 - 2011	Year 4 - 2010	Year 3 - 2009	Year 2 - 2008	Year 1 - 2007	Baseline	Bench
Area				25.14	25.35	23.43	
Width				19.23	19.24	19.06	
Mean Depth				1.31	1.32	1.23	
Max Depth				2.11	2.21	1.94	
W/D				14.71	14.59	15.51	
Wetted				22.60251686	19.60132026	19.7089936	
HR				1.112204018	1.293521623	1.188576833	

Overhills
Cross Section #6 (Pool)

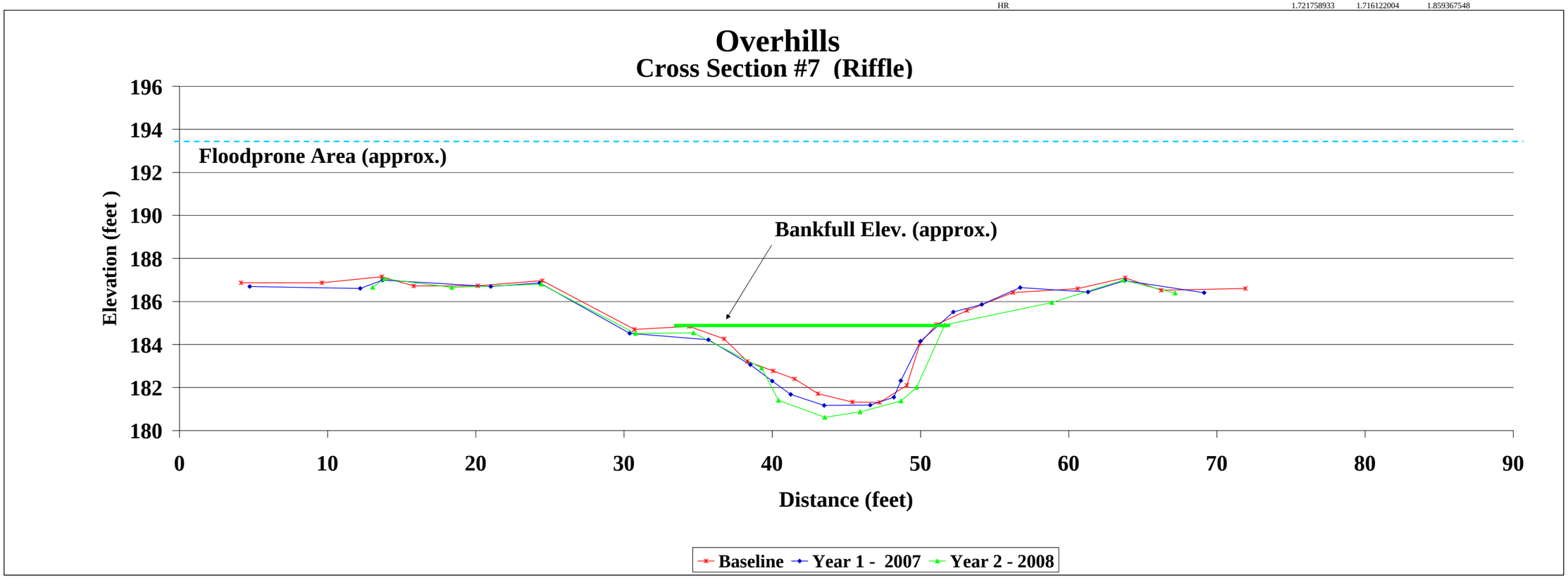


Project Name	Overhills
Cross Section	Cross Section 7
Feature	Riffle
Date	As Built - 07/04/08, Year 1 - 11/09/08, Year 2 - 08/12/08
Crew	As Built - Bidelspach, Jean, Geenen, Year 1&2 - Geenen, Ballestero

Year 5 - 2011 2011 Survey			Year 4 - 2010 2010 Survey			Year 3 - 2009 2009 Survey			Year 2 - 2008 2008 Survey			Year 1 - 2007 2007 Survey			Baseline Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
									13.04	186.66	0	4.74	186.69	0	4.15	186.87	0
									13.8	187.05	0	12.19	186.6	0	9.61	186.87	0
									18.38	186.65	0	13.71	186.99	0 Left Pin	13.66	187.15	0 Left Pin
									24.4	186.8	0 Left Pin	21.01	186.69	0	15.81	186.72	0
									30.78	184.51	3.900115	24.31	186.86	0	20.13	186.73	0
									34.68	184.54	4.870832 LBK	30.38	184.52	5.318468 LBK	24.47	186.97	0
									39.27	182.91	1.884038	35.69	184.22	3.058513	30.71	184.7	0
									40.41	181.41	3.240309	38.52	183.06	1.654841	34.39	184.84	2.430226 LBK
									43.55	180.61	2.39416	39.99	182.3	1.395314	36.75	184.26	1.888756
									45.93	180.87	2.804924	41.24	181.68	2.31683	38.32	183.21	1.79477
									48.69	181.37	1.229675	43.5	181.17	3.110016	40.06	182.77	1.496462
									49.74	182.01	3.372645	46.61	181.18	1.632483	41.51	182.4	1.714934
									51.62	184.91	0 RBK	48.2	181.55	0.902109	43.08	181.71	2.362414
									58.86	185.95	0	48.67	182.32	2.262256	45.41	181.32	1.830027
									63.69	186.99	0 Right Pin	50	184.15	1.316549	47.24	181.31	2.002424
									67.18	186.39	0	52.21	185.51	0 RBK	49.08	182.1	2.143502
												54.14	185.86	0	49.97	184.05	1.2735
												56.73	186.64	0	51.07	184.92	0 RBK
												61.3	186.44	0	53.14	185.58	0
												63.79	186.97	0 Right Pin	56.23	186.41	0
												69.14	186.4	0	60.6	186.59	0
															63.81	187.1	0 Right Pin
															66.24	186.52	0
															71.92	186.6	0

Photo of Cross-Section 7 - Looking Downstream @ STA 37+24

	Year 5 - 2011	Year 4 - 2010	Year 3 - 2009	Year 2 - 2008	Year 1 - 2007	Baseline	Bench
Area				40.80	39.41	35.21	
Width				16.68	16.68	16.54	
Mean Depth				2.45	2.36	2.13	
Max Depth				4.23	3.67	3.53	
W/D				6.82	7.06	7.77	
Wetted				23.69669715	22.96737735	18.93701638	
HR				1.721758933	1.716122004	1.859367548	

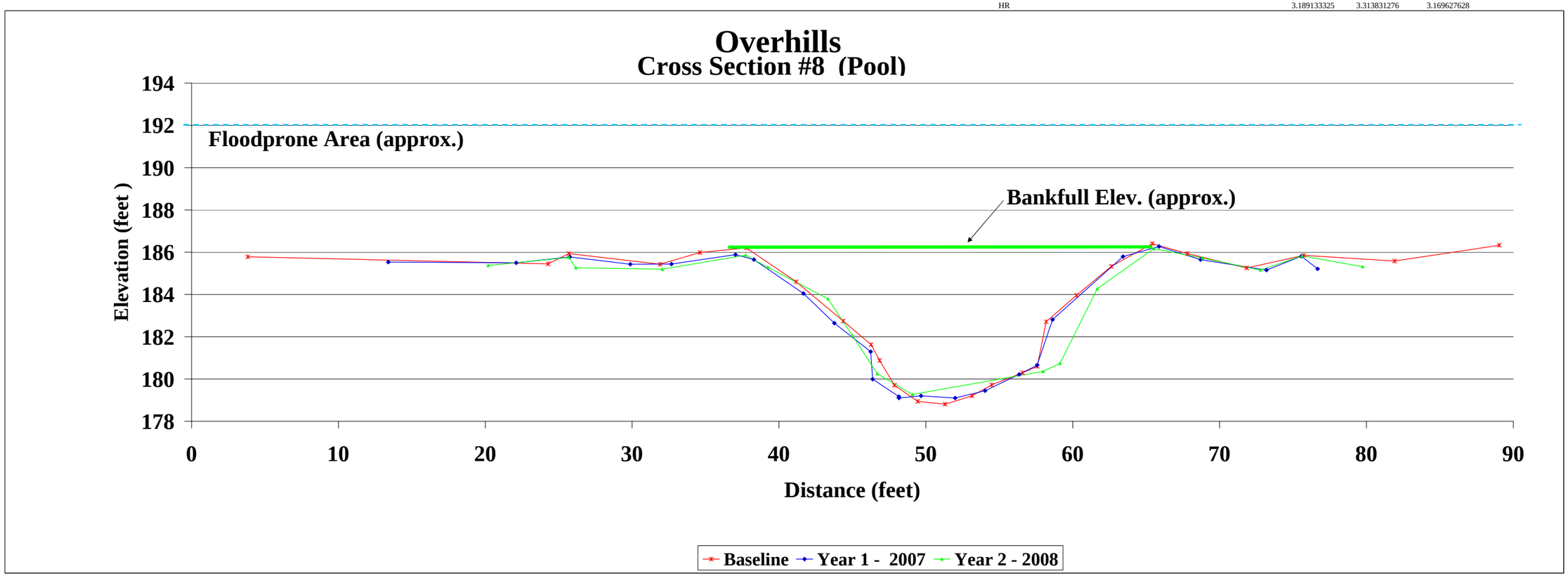


Project Name	Overhills
Cross Section	Cross Section 8
Feature	Pool
Date	As Built - 07/04/08, Year 1 - 11/09/08, Year 2 - 08/12/08
Crew	As Built - Bidelspach, Jean, Geenen, Year 1&2 - Geenen, Ballestero

Year 5 - 2011 2011 Survey			Year 4 - 2010 2010 Survey			Year 3 - 2009 2009 Survey			Year 2 - 2008 2008 Survey				Year 1 - 2007 2007 Survey				Baseline Survey			
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation		Notes	Station	Elevation		Notes	Station	Elevation		Notes
									20.2	185.37			13.4	185.53			3.83	185.78		
									25.7	185.75		Left Pin	22.11	185.5			24.28	185.45		
									26.17	185.26			25.75	185.77		Left Pin	25.7	185.93		Left Pin
									32.05	185.19			29.88	185.43			31.91	185.43		
									37.73	185.86	1.614001	LBK	32.68	185.44			34.62	185.98		
									39.24	185.29	4.356386		37.04	185.88	1.28082	LBK	37.77	186.2	3.748734	LBK
									43.33	183.79	2.397603		38.3	185.65	3.734836		41.17	184.6	3.701297	
									44.99	182.06	2.483163		41.67	184.04	2.523886		44.37	182.74	2.200477	
									46.69	180.25	2.583118		43.77	182.64	2.814853		46.27	181.63	0.948103	
									49.08	179.27	8.976425	RBK	46.24	181.29	1.307517		46.85	180.88	1.553222	
									57.99	180.36	1.211156		46.38	179.99	1.959796		47.86	179.7	1.753283	
									59.14	180.74	4.343017		48.16	179.17	0.070711		49.44	178.94	1.874513	
									61.67	184.27	4.302278		48.17	179.1	1.50333		51.31	178.81	1.871096	
									65.53	186.17	3.33054		49.67	179.2	2.322154		53.14	179.2	1.437359	
									68.83	185.72			51.99	179.1	2.078004		54.48	179.72	2.175983	RBK
									72.79	185.15			54.04	179.44	2.447611	RBK	56.58	180.29	1.053613	
									75.6	185.82		Right Pin	56.36	180.22	1.284134		57.59	180.59	2.20327	
									79.74	185.31			57.57	180.65	2.406076		58.19	182.71	2.41814	
													58.63	182.81	5.641321		60.26	183.96	2.737481	
													63.42	185.79	2.112729		62.63	185.33	2.419	
													65.87	186.27			65.42	186.4	1.379582	
													68.7	185.65			67.81	185.93		
													73.19	185.15			71.84	185.25		
													75.56	185.81		Right Pin	75.73	185.85		Right Pin
													76.68	185.21			81.92	185.58		
																	89.04	186.33	0	

Photo of Cross-Section 8 - Looking Downstream @ STA 43+02

	Year 5 - 2011	Year 4 - 2010	Year 3 - 2009	Year 2 - 2008	Year 1 - 2007	Baseline	Bench
Area				113.53	110.97	106.10	
Width				27.69	27.72	27.10	
Mean Depth				4.10	4.00	3.92	
Max Depth				6.92	7.09	7.38	
W/D				6.75	6.92	6.92	
Wetted				35.5976894	33.48777667	33.4751523	
HR				3.189133325	3.313831276	3.169627628	

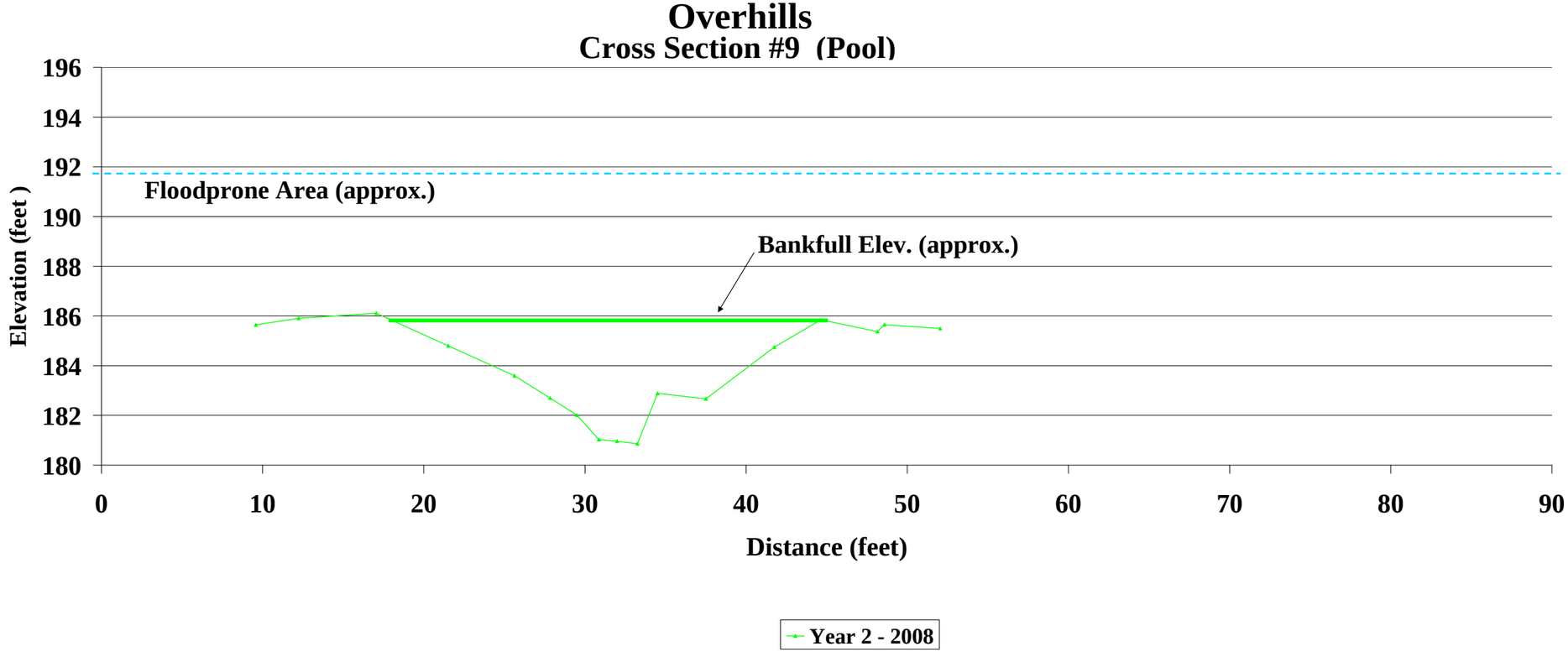


Project Name	Overhills
Cross Section	Cross Section 9
Feature	Pool
Date	Year 2 -08/12/08
Crew	Year 2 - Geenen, Ballestero

Year 5 - 2011 2011 Survey			Year 4 - 2010 2010 Survey			Year 3 - 2009 2009 Survey			Year 2 - 2008 2008 Survey			Year 1 - 2007 2007 Survey			Baseline Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
									9.58	185.64							
									12.23	185.91	0 Left Pin						
									17.05	186.11	0 BKF						
									21.52	184.8	4.272002						
									25.62	183.6	2.386231						
									27.83	182.7	1.806931						
									29.5	182.01	1.676305						
									30.86	181.03	1.132166						
									31.99	180.96	1.273931						
									33.26	180.86	2.37876						
									34.5	182.89	3.008056						
									37.5	182.67	4.731691						
									41.75	184.75	3.101612						
									44.65	185.85	3.522854 BKF						
									48.14	185.37							
									48.58	185.65	Right Pin						
									52.04	185.5							

Photo of Cross-Section 9 - Looking Downstream @ STA 39+30

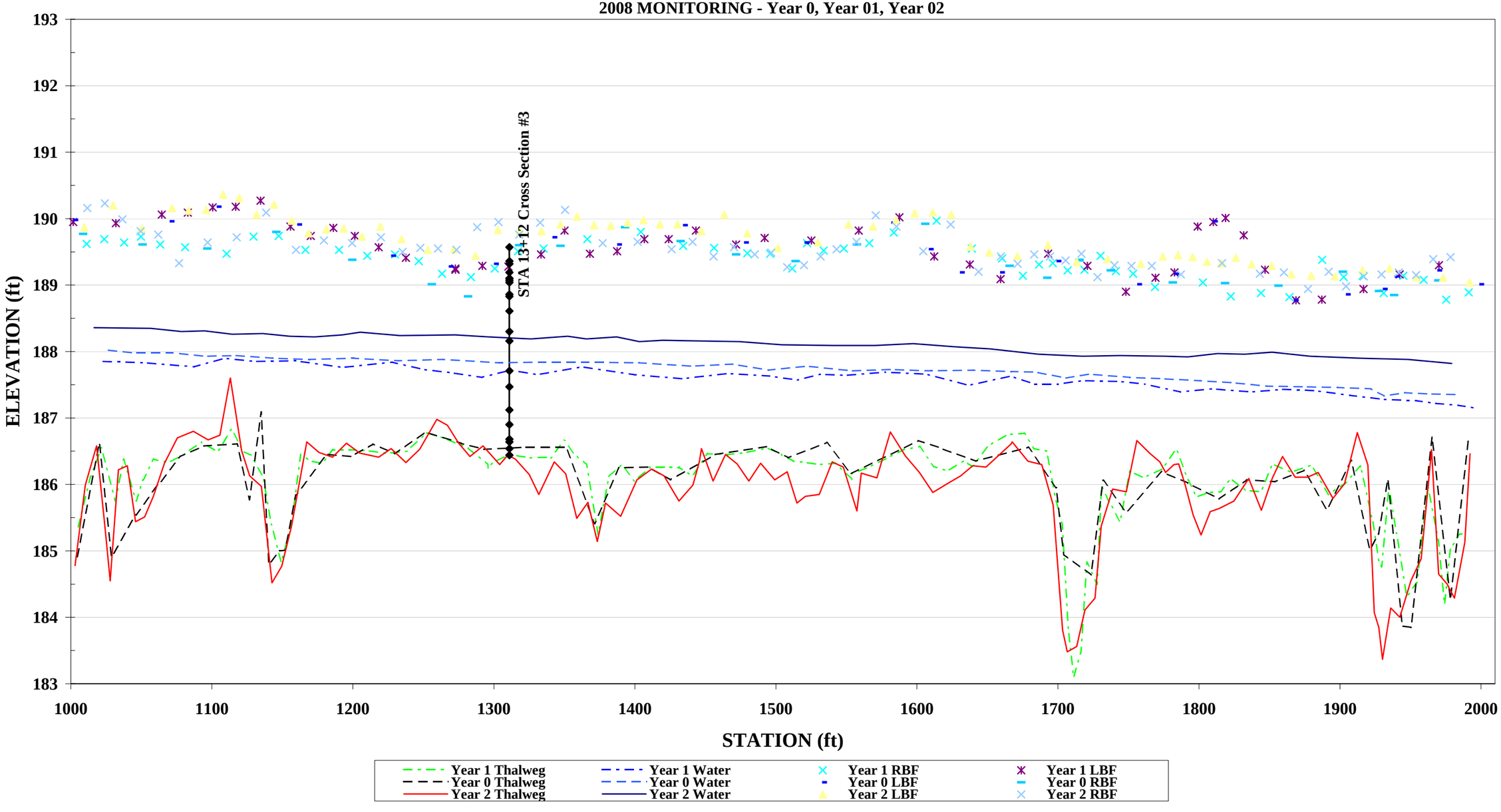
	Year 5 - 2011	Year 4 - 2010	Year 3 - 2009	Year 2 - 2008	Year 1 - 2007	Baseline	Bench
Area				62.93			
Width				26.71			
Mean Depth				2.36			
Max Depth				4.99			
W/D				11.34			
Wet				29.29054026			
HR				2.15			



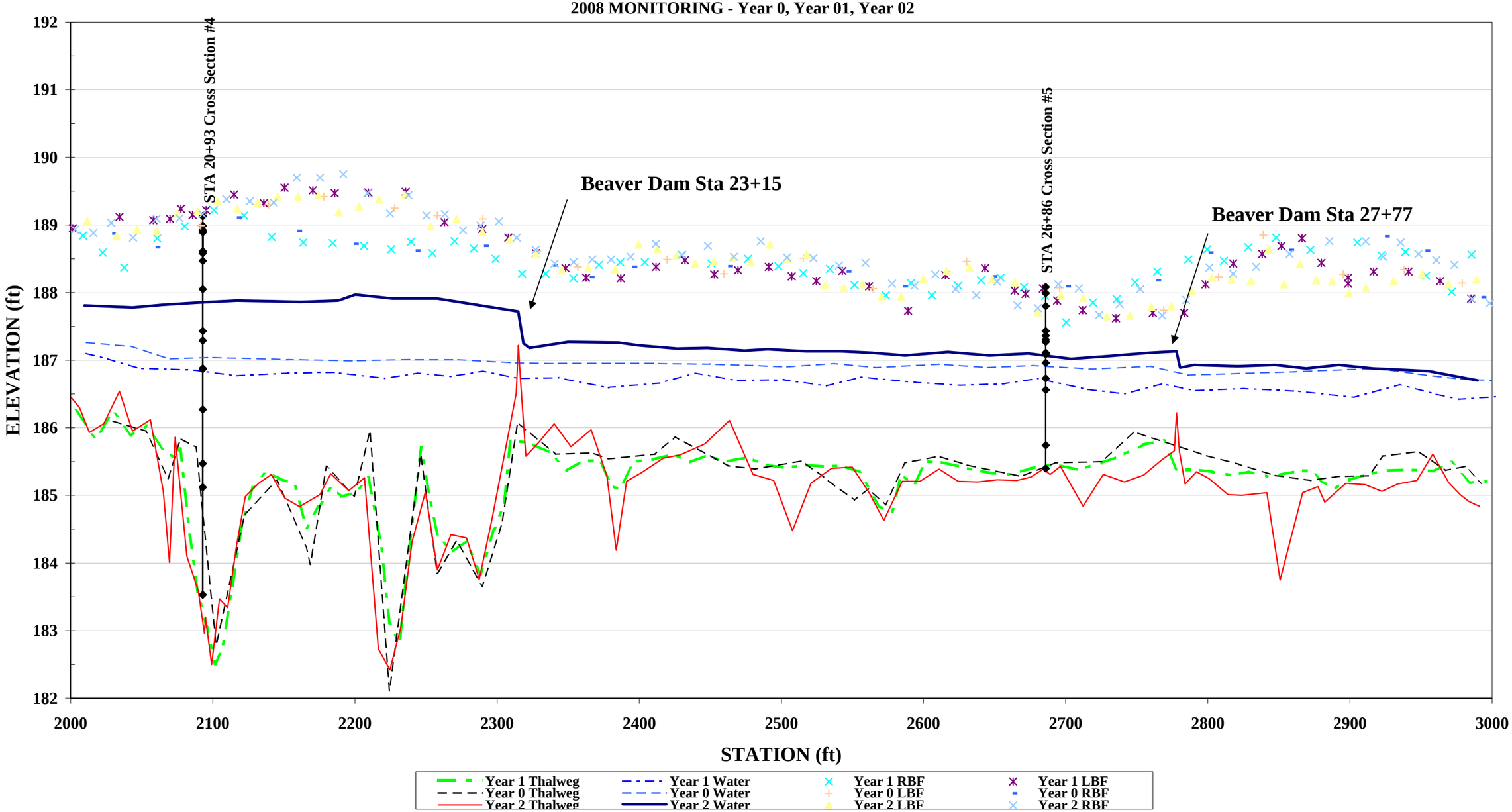
B.7 LONGITUDINAL PLOTS

Overhills Profile
Upper Reach
STA 0+00 - STA 10+00
2008 MONITORING - Year 0, Year 01, Year 02

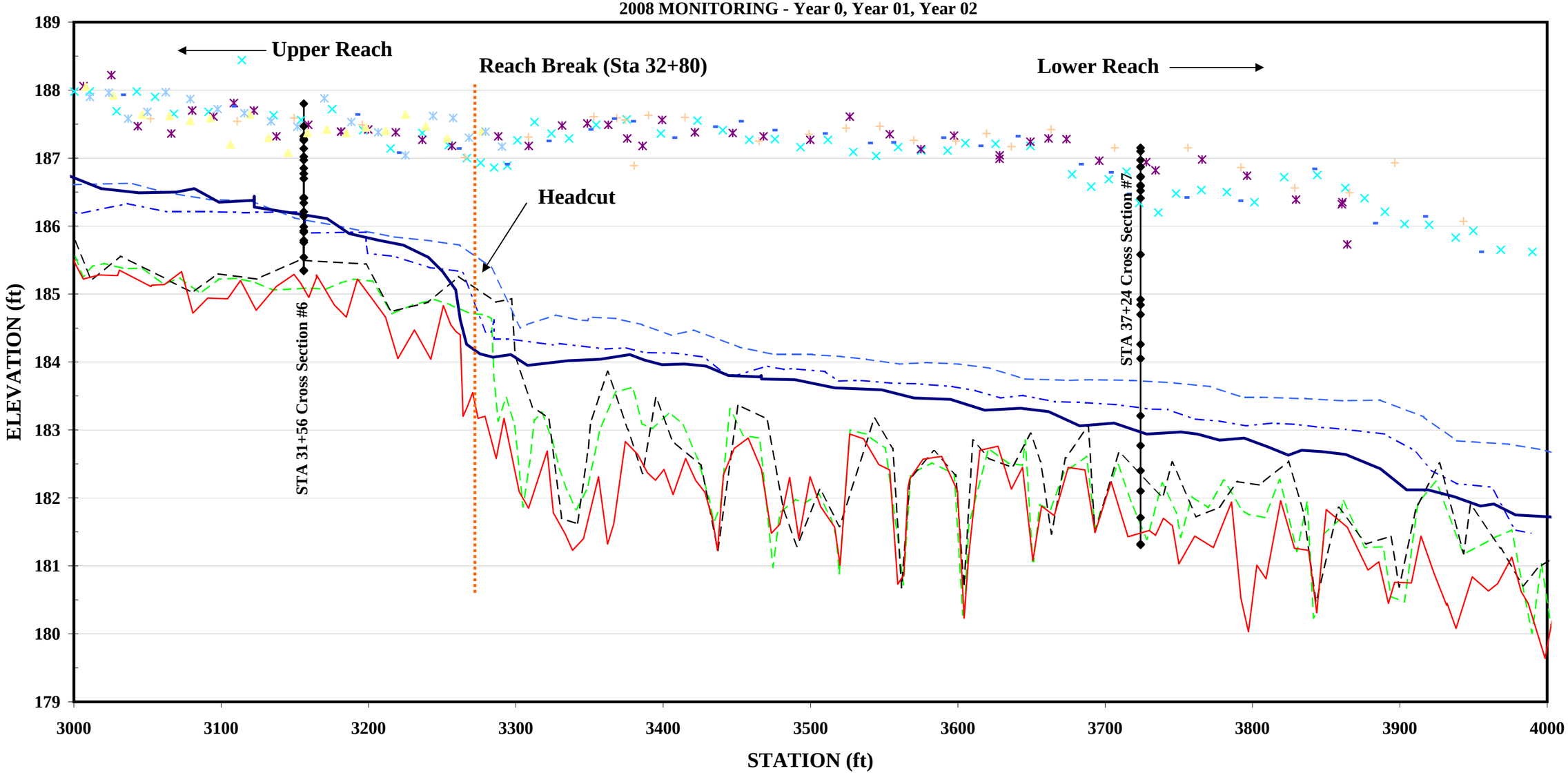
Overhills Profile
Upper Reach
STA 10+00 - STA 20+00
2008 MONITORING - Year 0, Year 01, Year 02



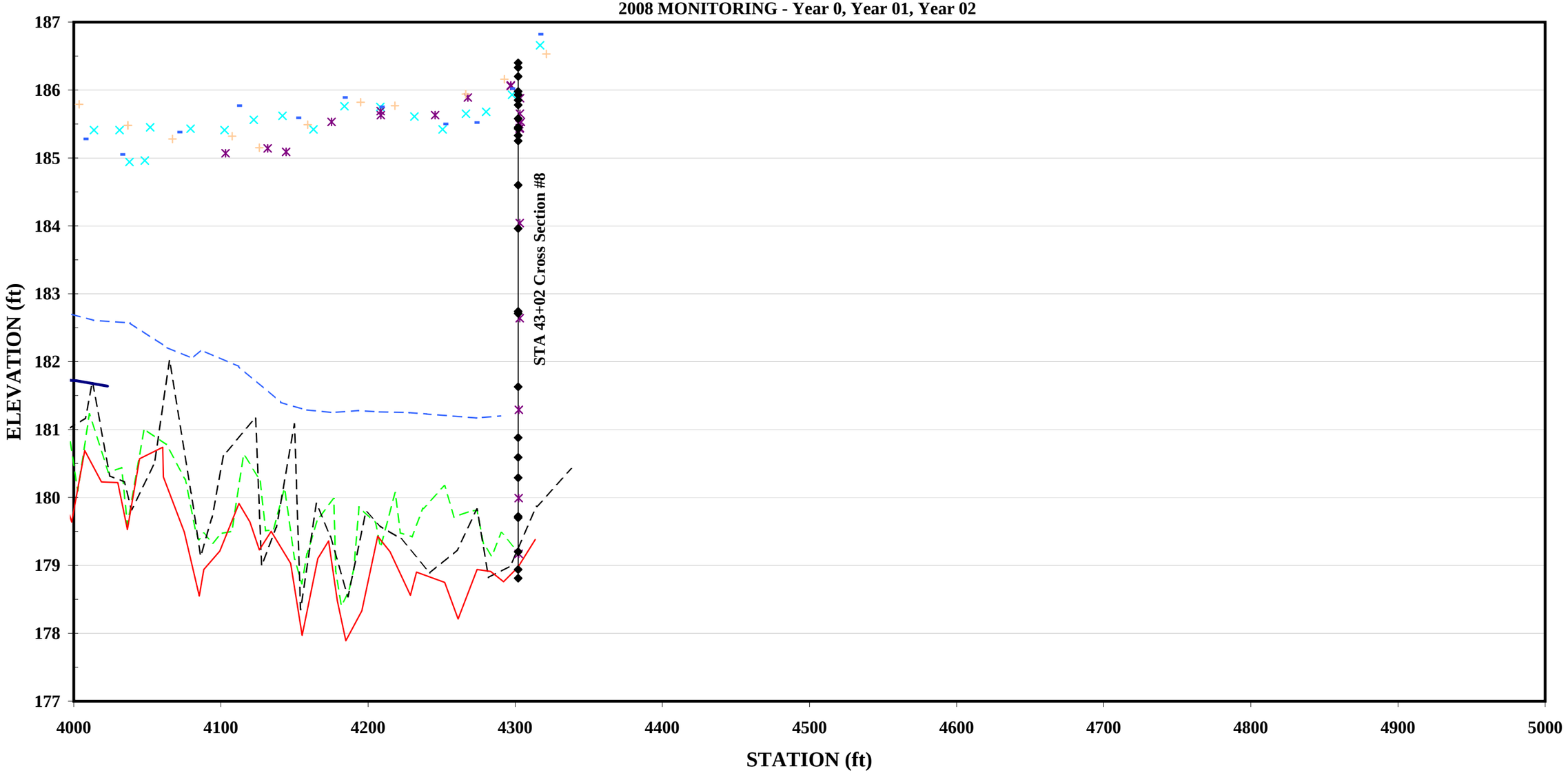
Overhills Profile
Upper Reach
STA 20+00 - STA 30+00
2008 MONITORING - Year 0, Year 01, Year 02



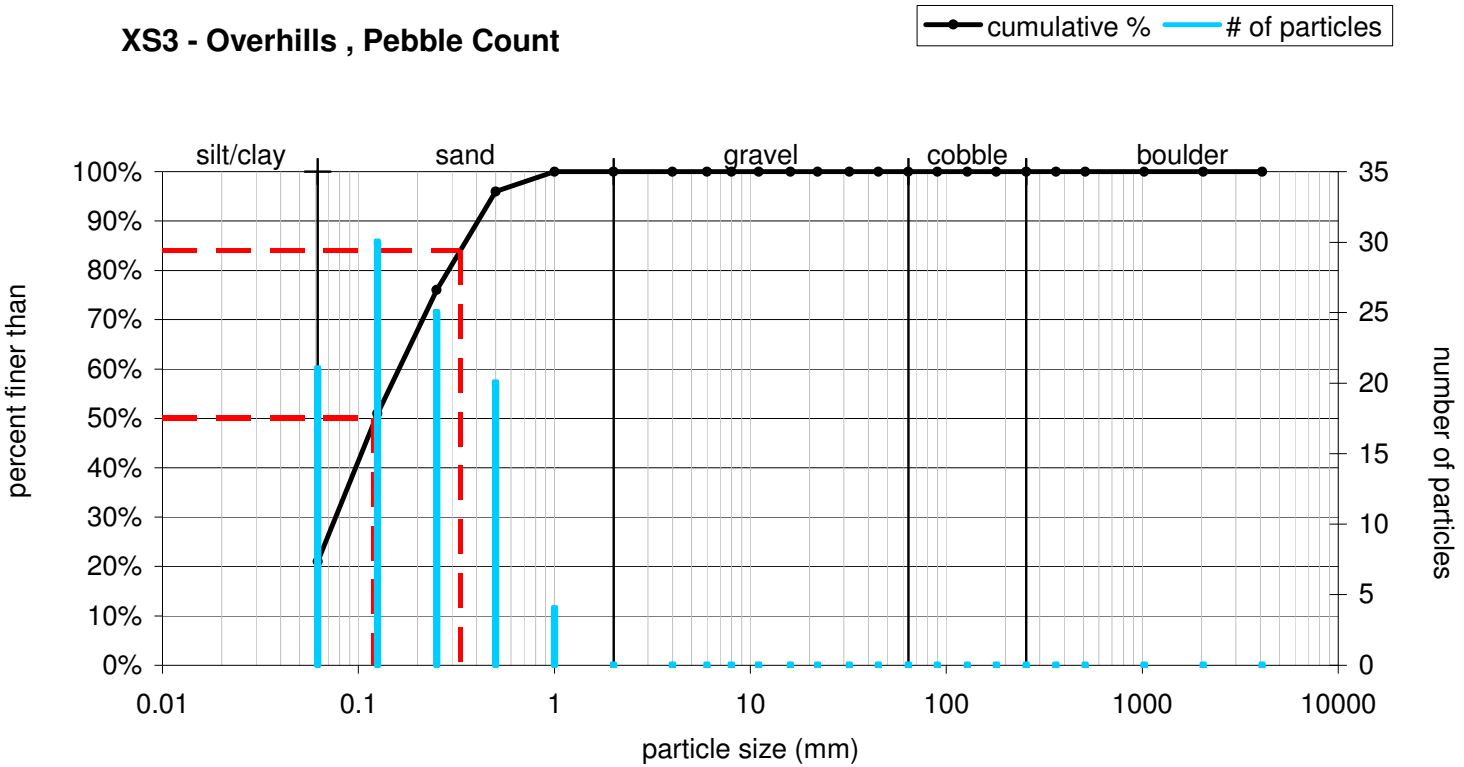
Overhills Profile
Upper & Lower Reaches
STA 30+00 - STA 40+00
2008 MONITORING - Year 0, Year 01, Year 02



Overhills Profile
Lower Reach
STA 40+00 - STA 50+00
2008 MONITORING - Year 0, Year 01, Year 02



B.8 PEBBLE COUNT DISTRIBUTION

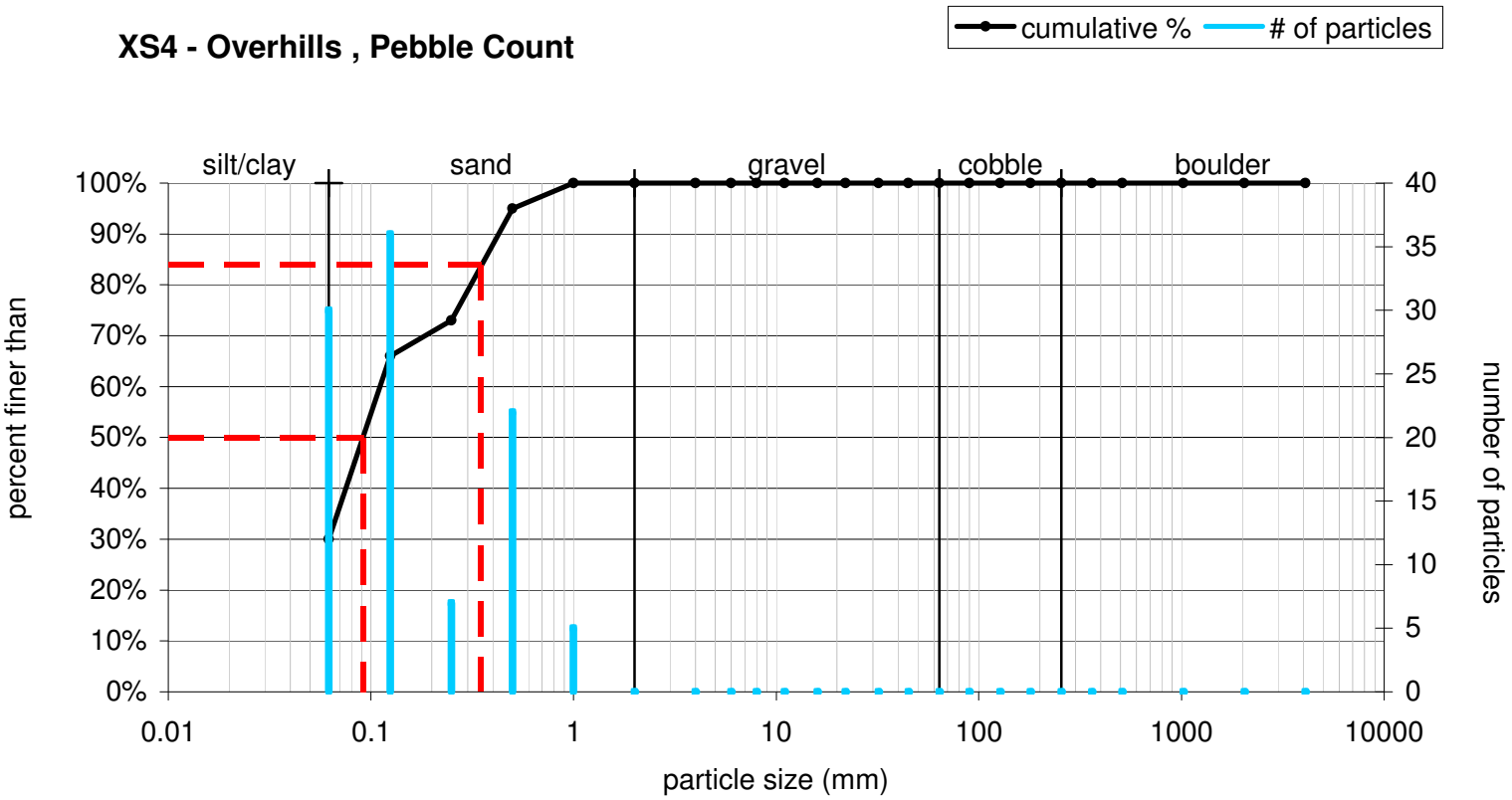


Size (mm)	
D16	0.062
D35	0.086
D50	0.12
D65	0.18
D84	0.33
D95	0.48

Size Distribution	
mean	0.1
dispersion	2.3
skewness	0.09

Type	
silt/clay	21%
sand	79%
gravel	0%
cobble	0%
boulder	0%

XS4 - Overhills , Pebble Count

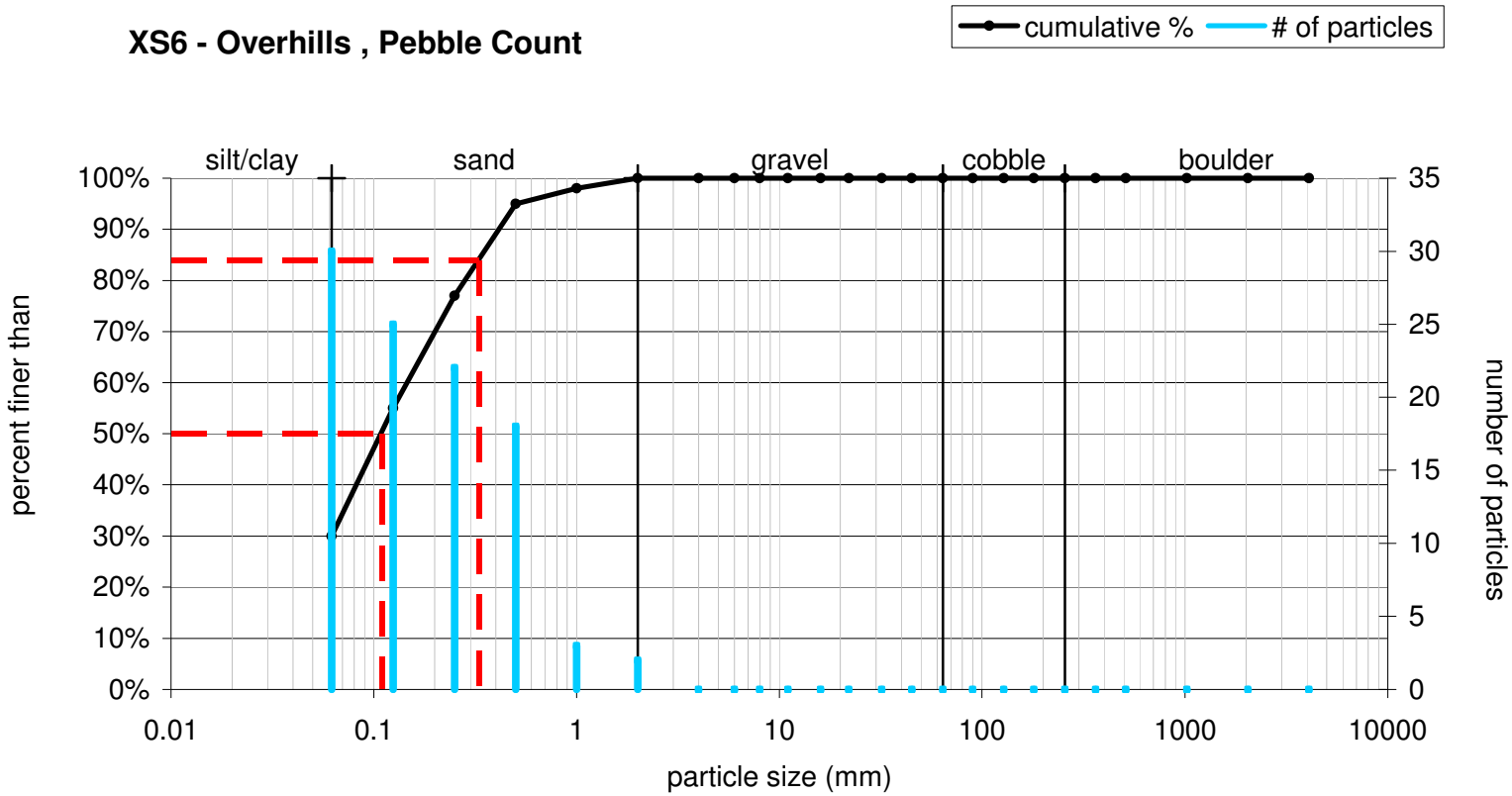


Size (mm)	
D16	0.062
D35	0.068
D50	0.092
D65	0.12
D84	0.35
D95	0.5

Size Distribution	
mean	0.1
dispersion	2.6
skewness	0.24

Type	
silt/clay	30%
sand	70%
gravel	0%
cobble	0%
boulder	0%

XS6 - Overhills , Pebble Count

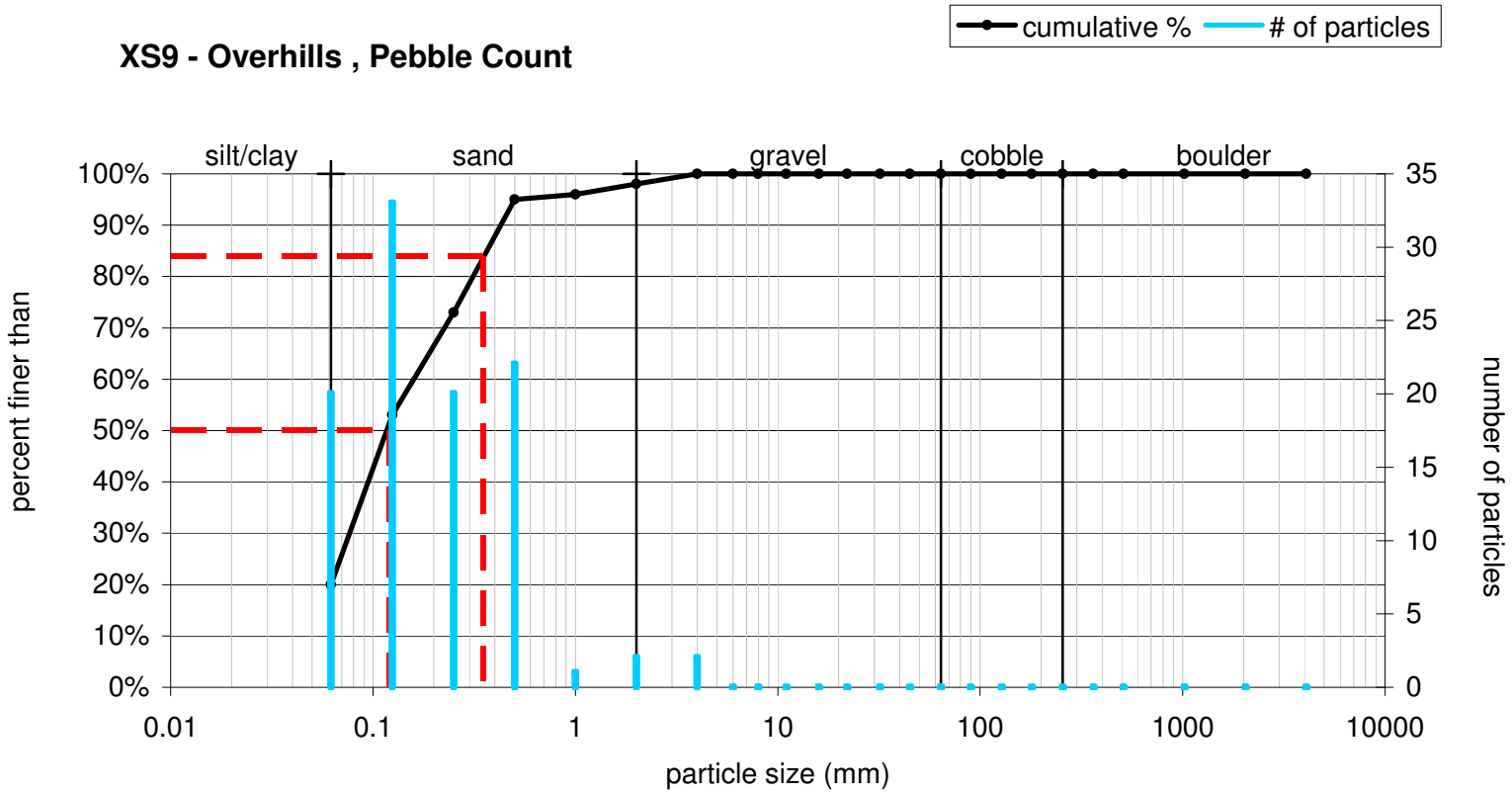


Size (mm)	
D16	0.062
D35	0.071
D50	0.11
D65	0.17
D84	0.33
D95	0.5

Size Distribution	
mean	0.1
dispersion	2.4
skewness	0.13

Type	
silt/clay	30%
sand	70%
gravel	0%
cobble	0%
boulder	0%

XS9 - Overhills , Pebble Count



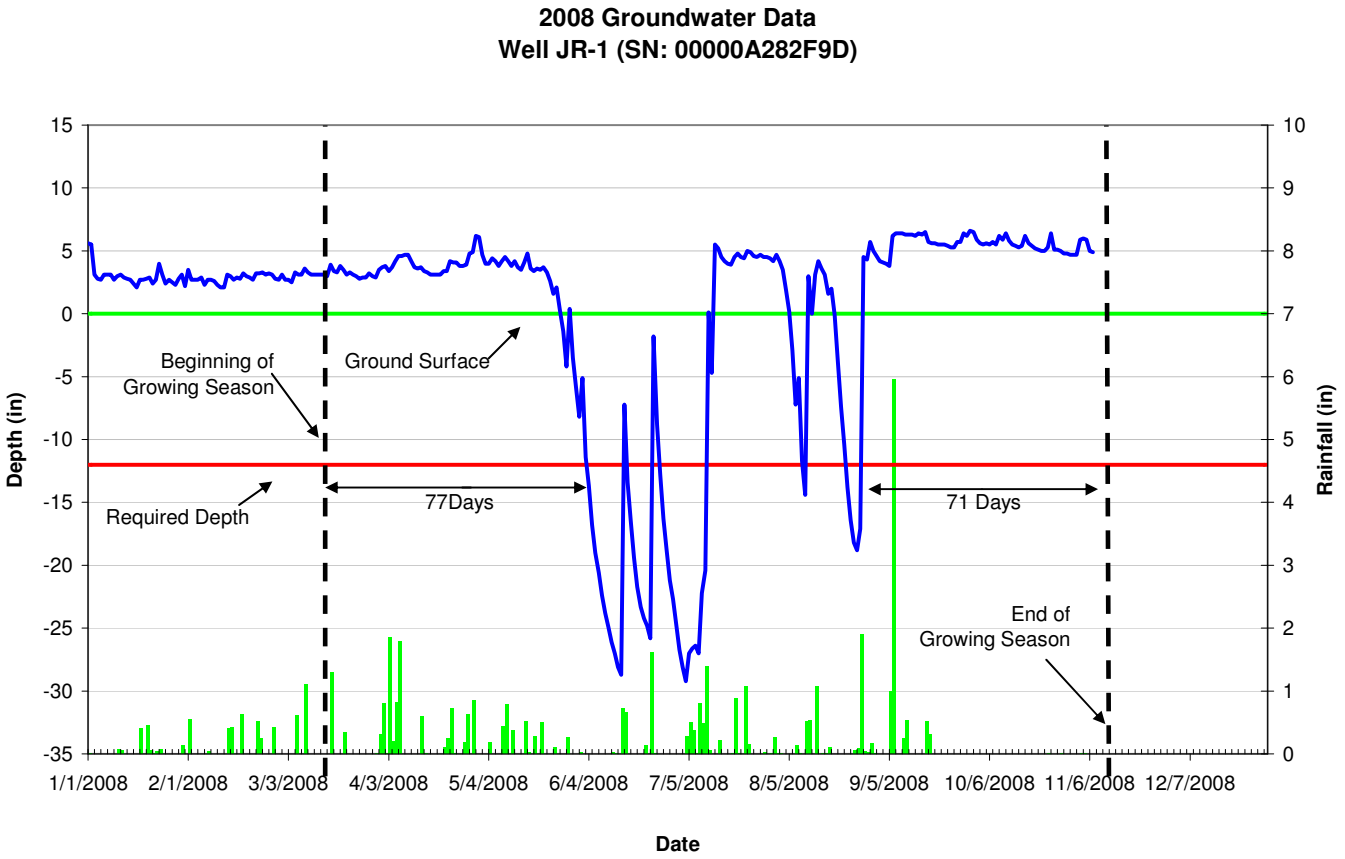
Size (mm)	
D16	0.062
D35	0.085
D50	0.12
D65	0.19
D84	0.35
D95	0.5

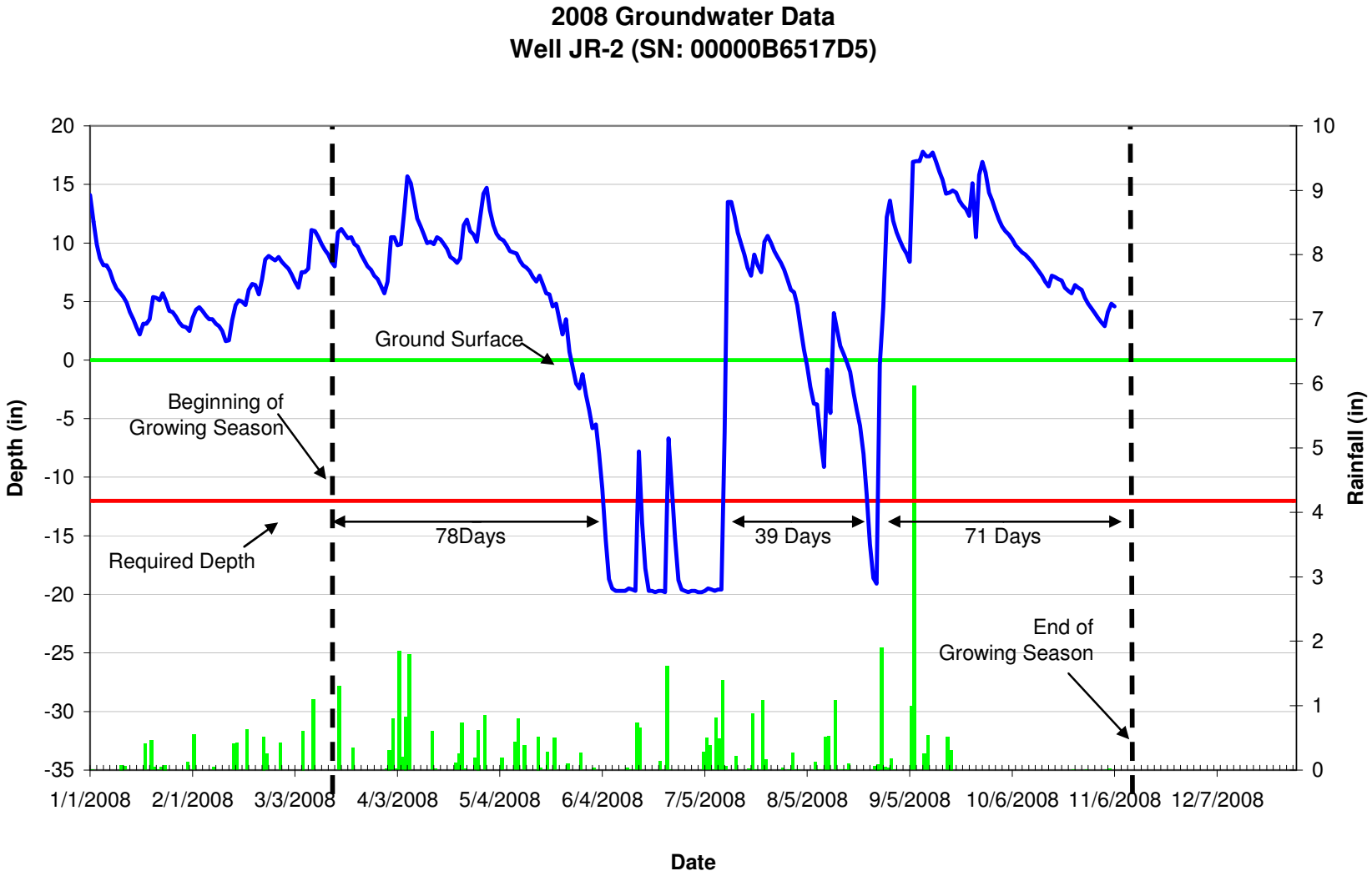
Size Distribution	
mean	0.1
dispersion	2.4
skewness	0.10

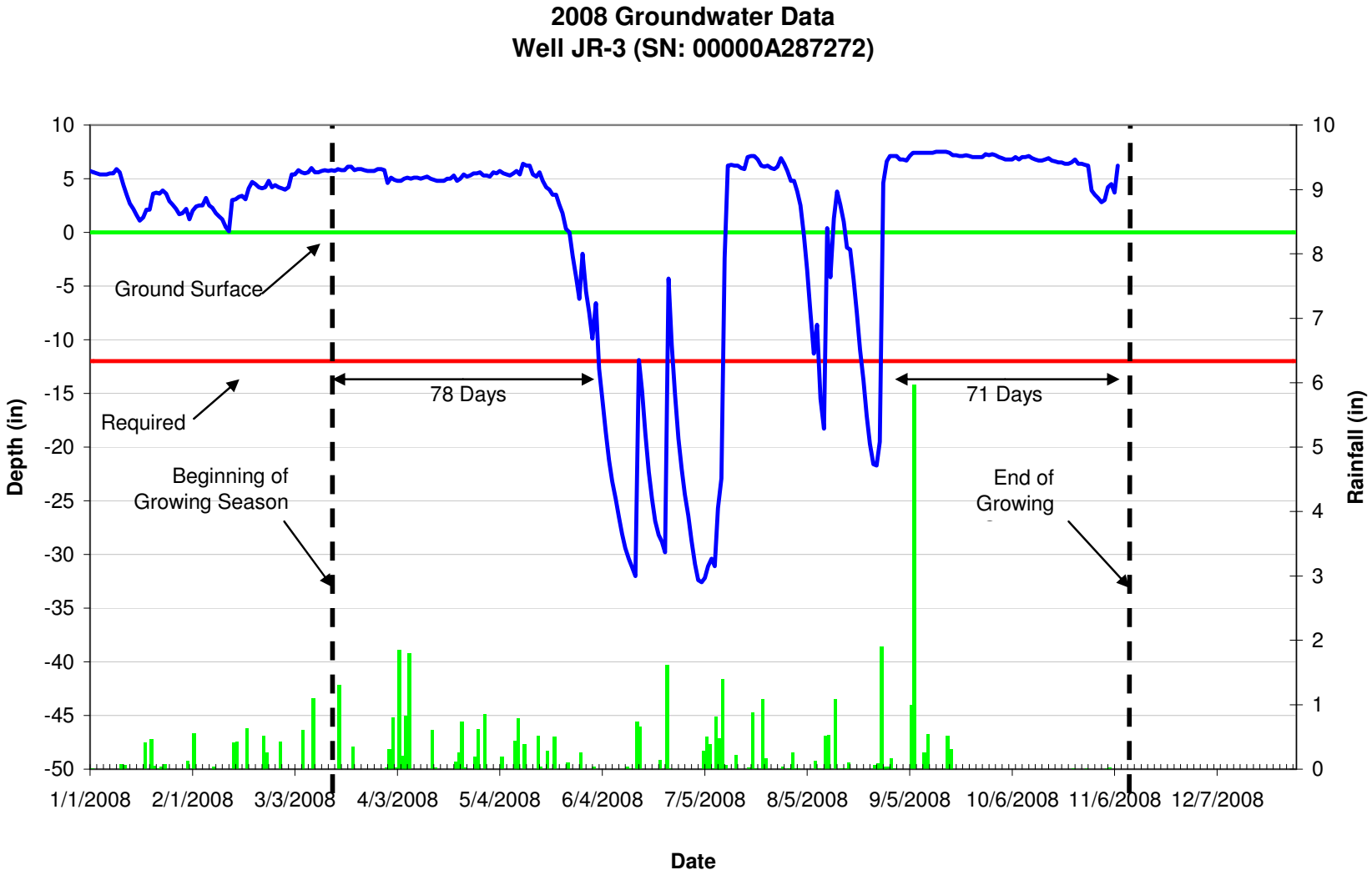
Type	
silt/clay	20%
sand	78%
gravel	2%
cobble	0%
boulder	0%

Appendix C. Wetland Raw Data

C.1 GAUGE DATA




2008 Groundwater Data
Well JR-2 (SN: 00000B6517D5)
Depth (in)
Rainfall (in)
Date
Ground Surface
Beginning of Growing Season
Required Depth
78Days
39 Days
71 Days
End of Growing Season
20
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
10
9
8
7
6
5
4
3
2
1
0
1/1/2008
2/1/2008
3/3/2008
4/3/2008
5/4/2008
6/4/2008
7/5/2008
8/5/2008
9/5/2008
10/6/2008
11/6/2008
12/7/2008


2008 Groundwater Data
Well JR-3 (SN: 00000A287272)
Depth (in)
Rainfall (in)
Date
Ground Surface
Required
Beginning of Growing Season
78 Days
71 Days
End of Growing
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
9
8
7
6
5
4
3
2
1
0
1/1/2008
2/1/2008
3/3/2008
4/3/2008
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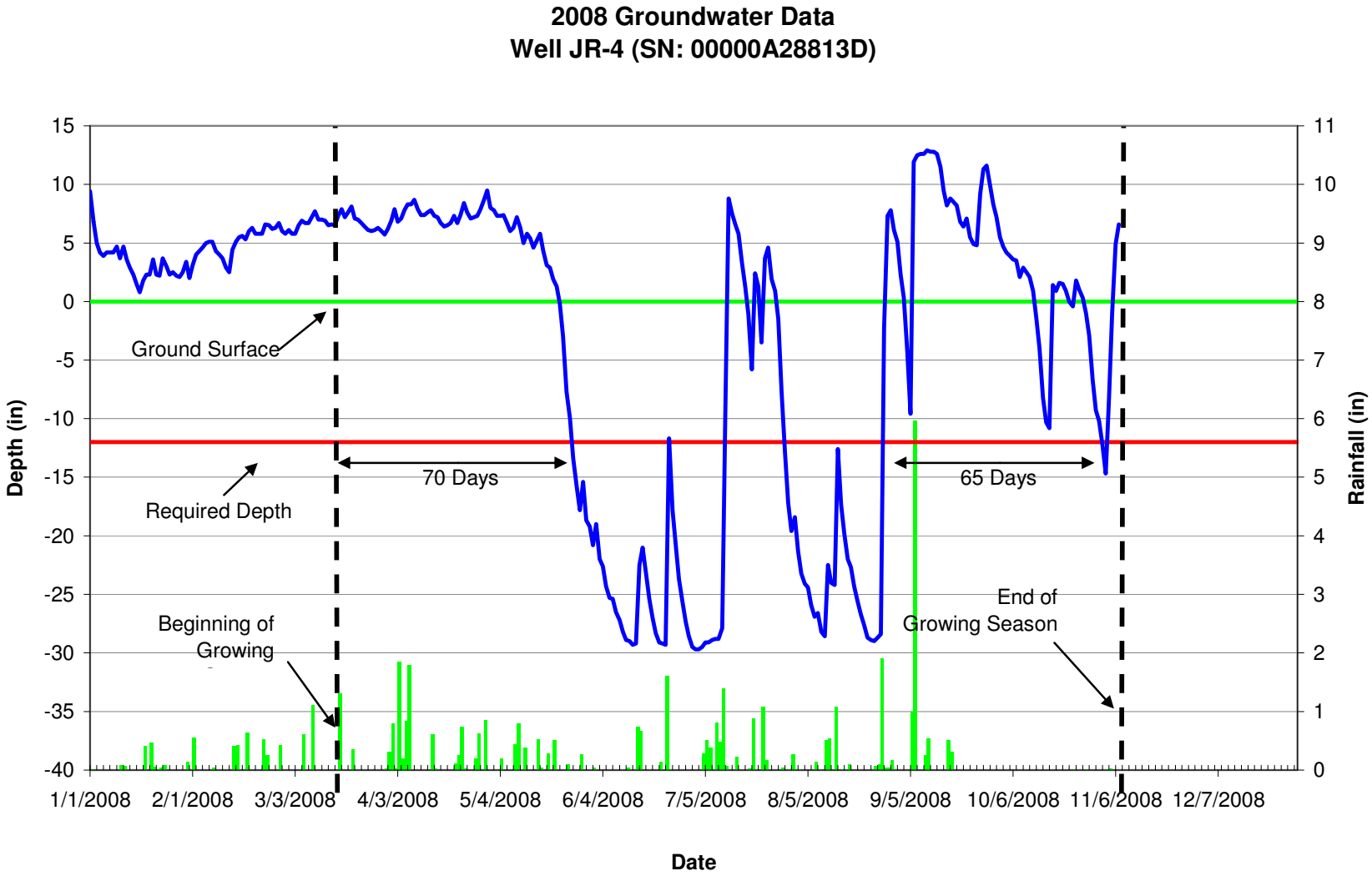
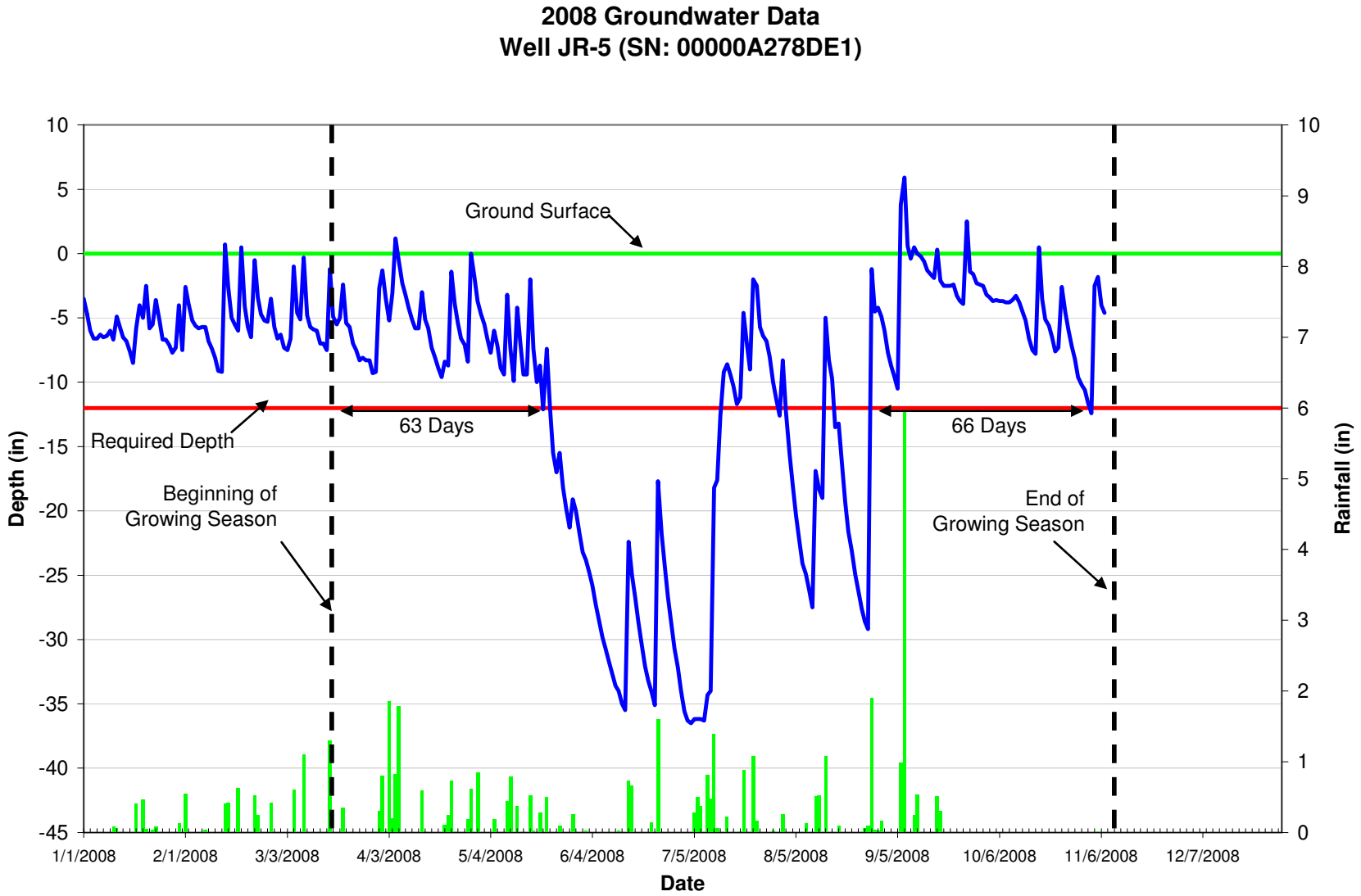
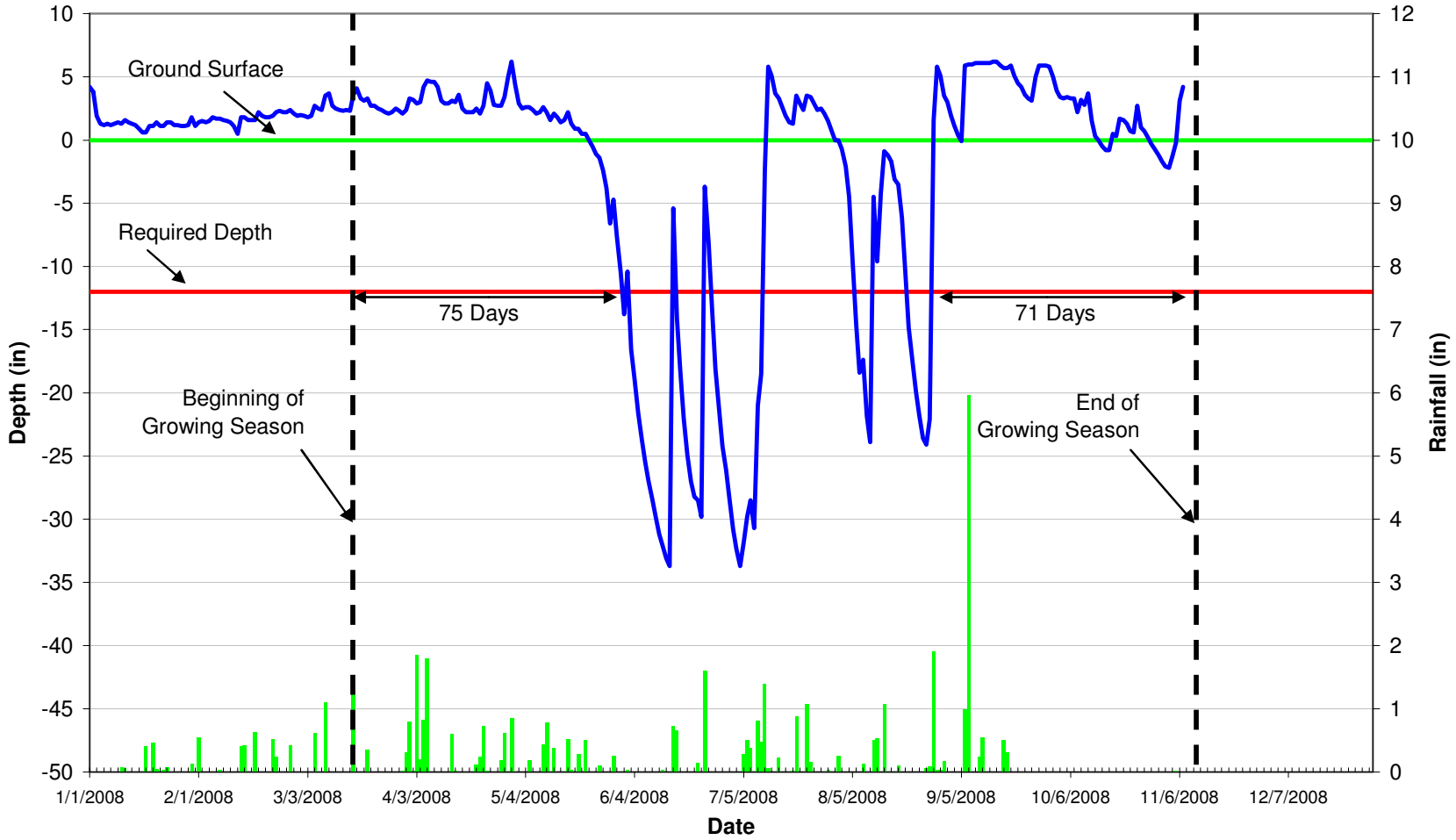
9/5/2008
10/6/2008
11/6/2008
12/7/2008

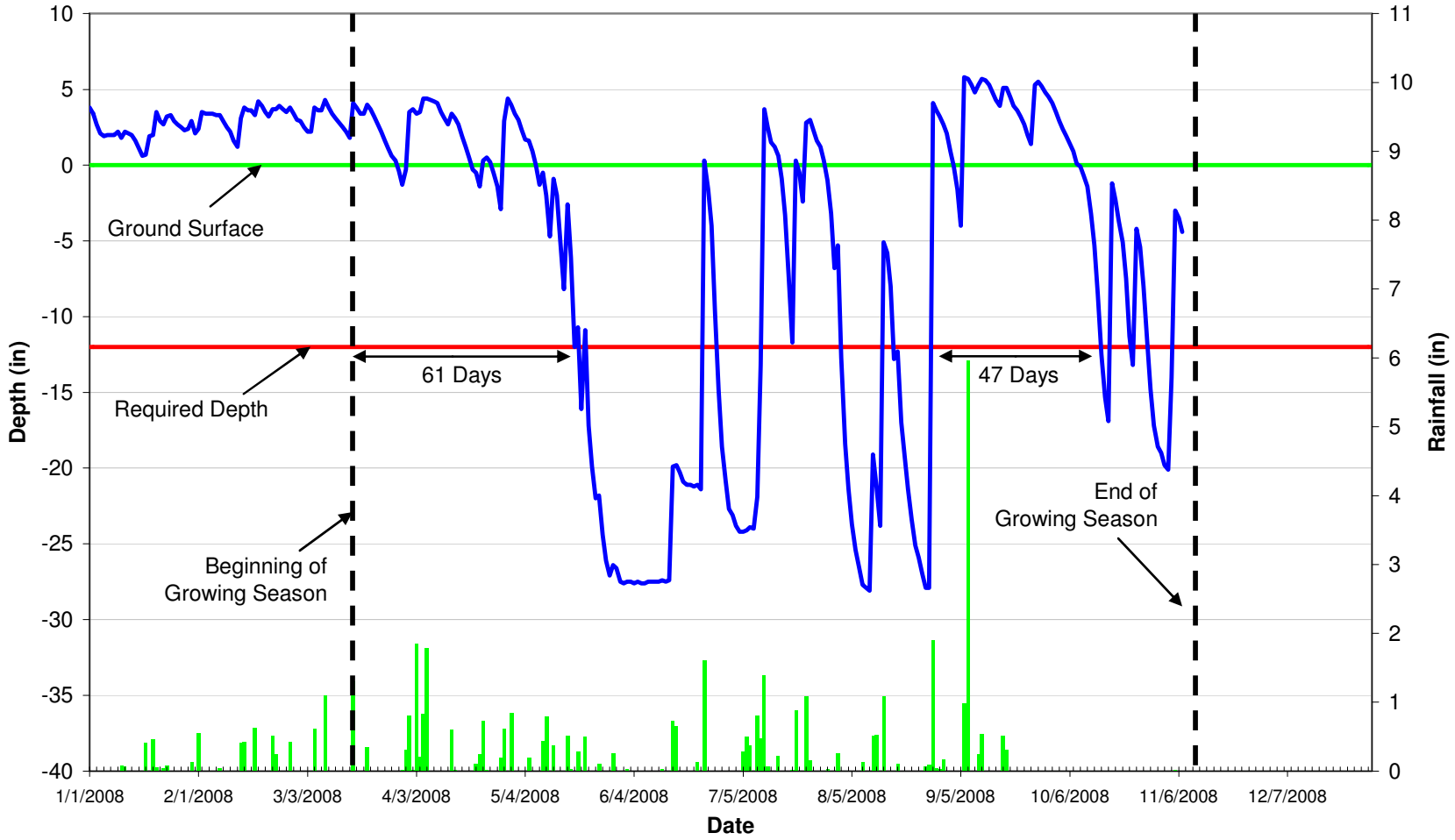

2008 Groundwater Data
Well JR-4 (SN: 00000A28813D)
Depth (in)
Rainfall (in)
Date
Ground Surface
Required Depth
70 Days
65 Days
Beginning of Growing
End of Growing Season
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
11
10
9
8
7
6
5
4
3
2
1
0
1/1/2008
2/1/2008
3/3/2008
4/3/2008
5/4/2008
6/4/2008
7/5/2008
8/5/2008
9/5/2008
10/6/2008
11/6/2008
12/7/2008


2008 Groundwater Data
Well JR-5 (SN: 00000A278DE1)
Depth (in)
Rainfall (in)
Date
Ground Surface
Required Depth
63 Days
66 Days
Beginning of Growing Season
End of Growing Season
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
9
8
7
6
5
4
3
2
1
0
1/1/2008
2/1/2008
3/3/2008
4/3/2008
5/4/2008
6/4/2008
7/5/2008
8/5/2008
9/5/2008
10/6/2008
11/6/2008
12/7/2008

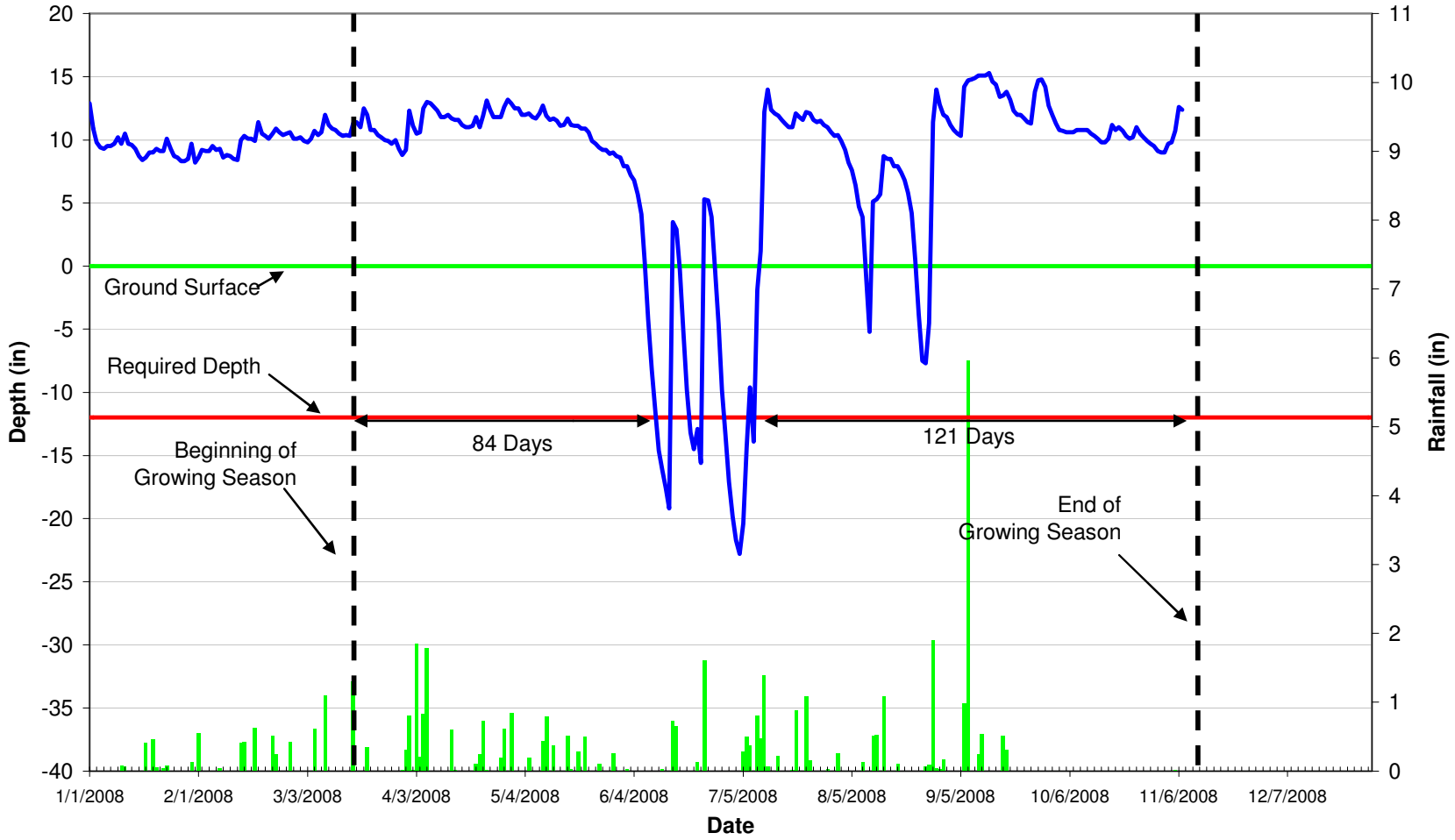
2008 Groundwater Data
Well JR-6 (SN: 00000A28A0D9)



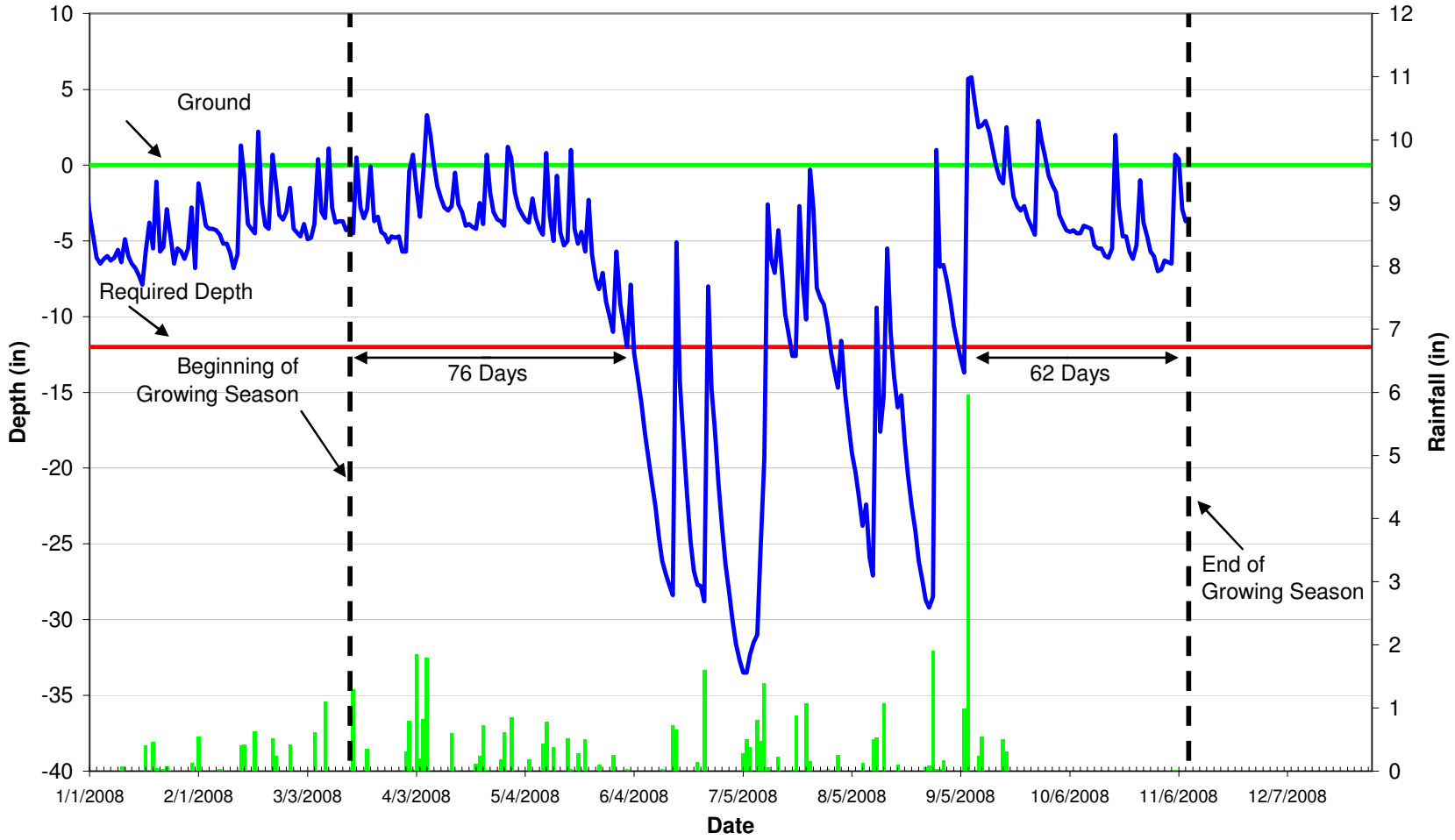
2008 Groundwater Data
Well JR-7 (SN: 00000AB36E51)



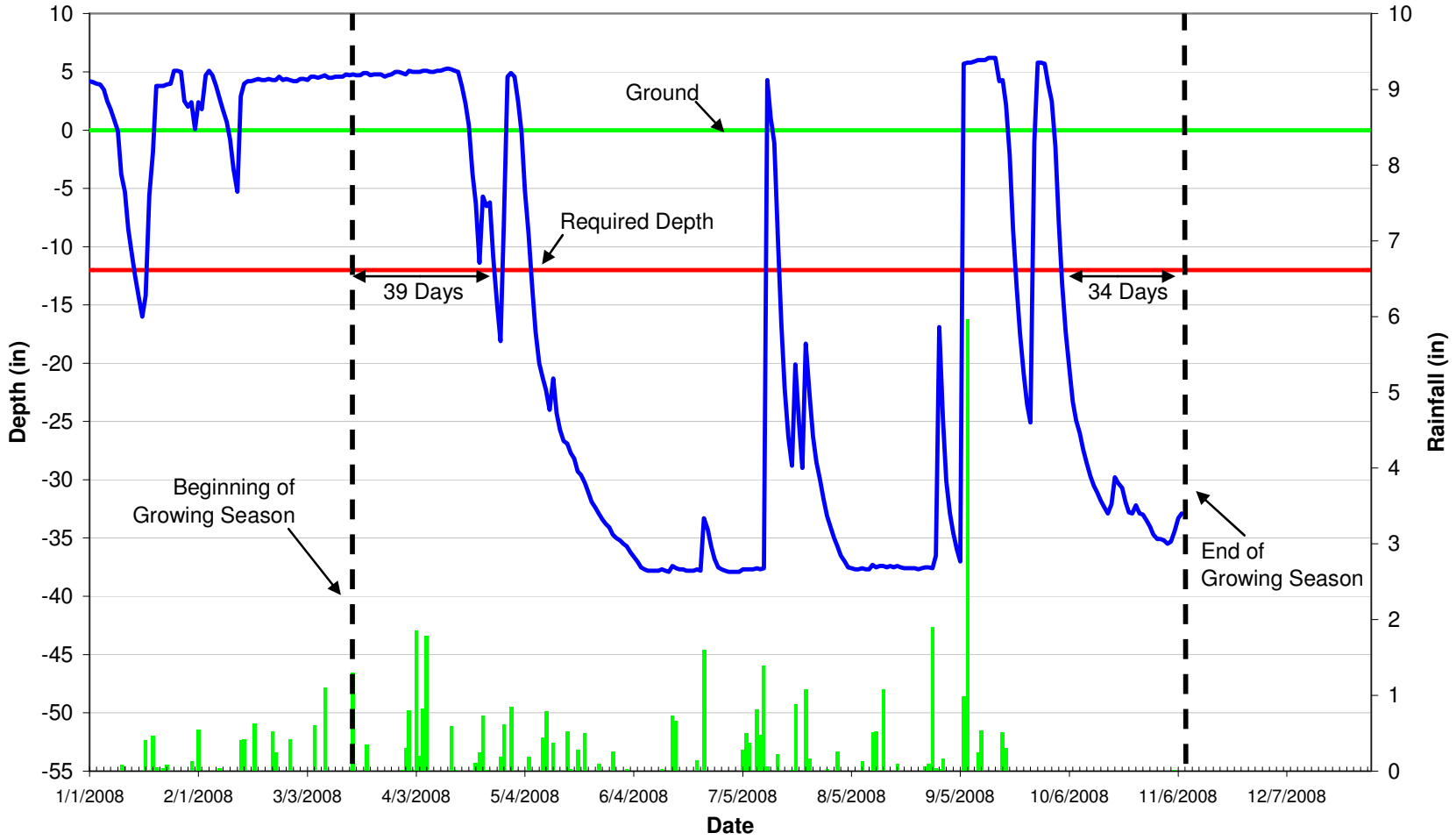
2008 Groundwater Data
Well JR-8 (SN: 00000AB372F9)

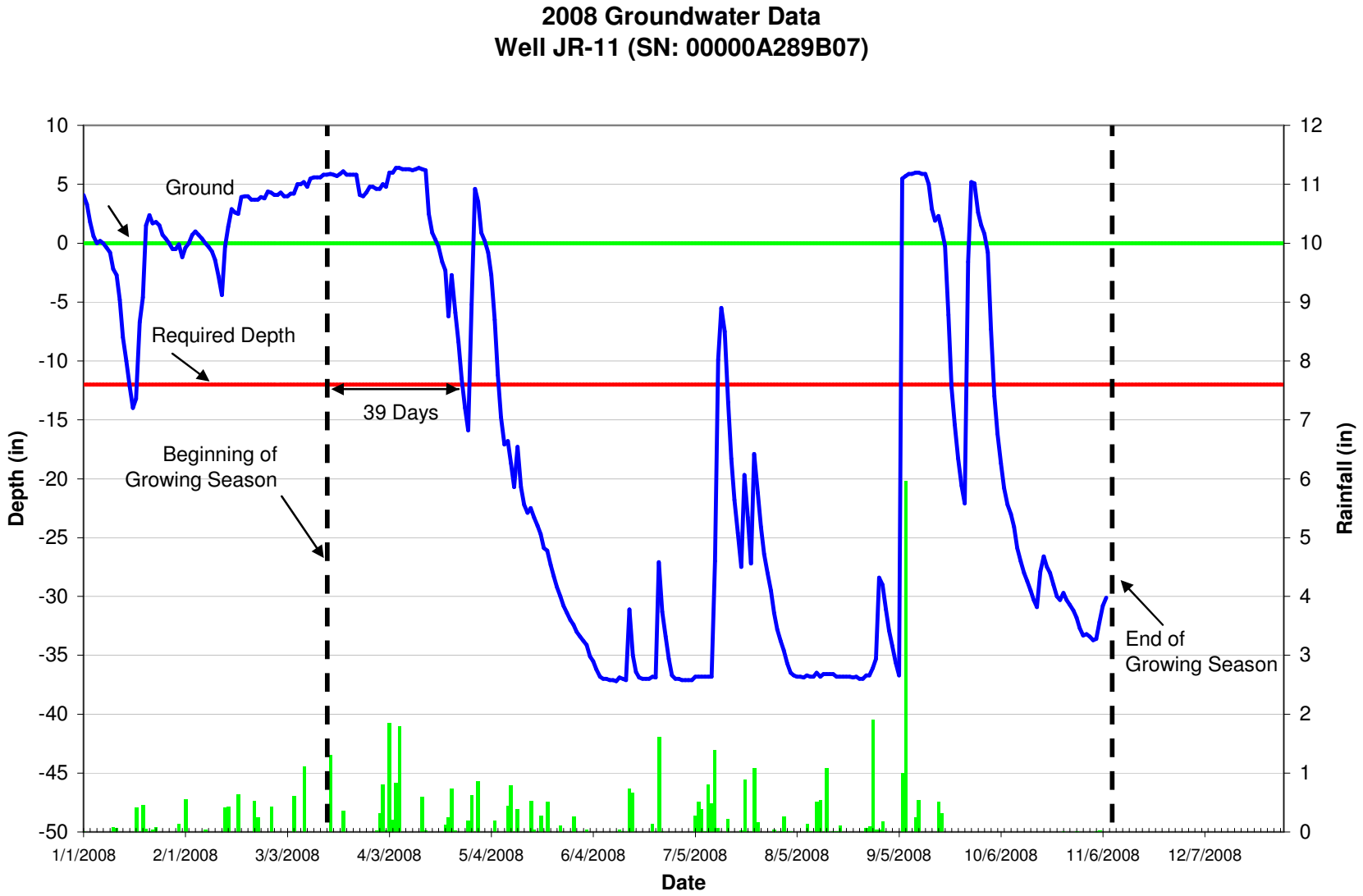


2008 Groundwater Data
Well JR-9 (SN: 00000AB35FB9)

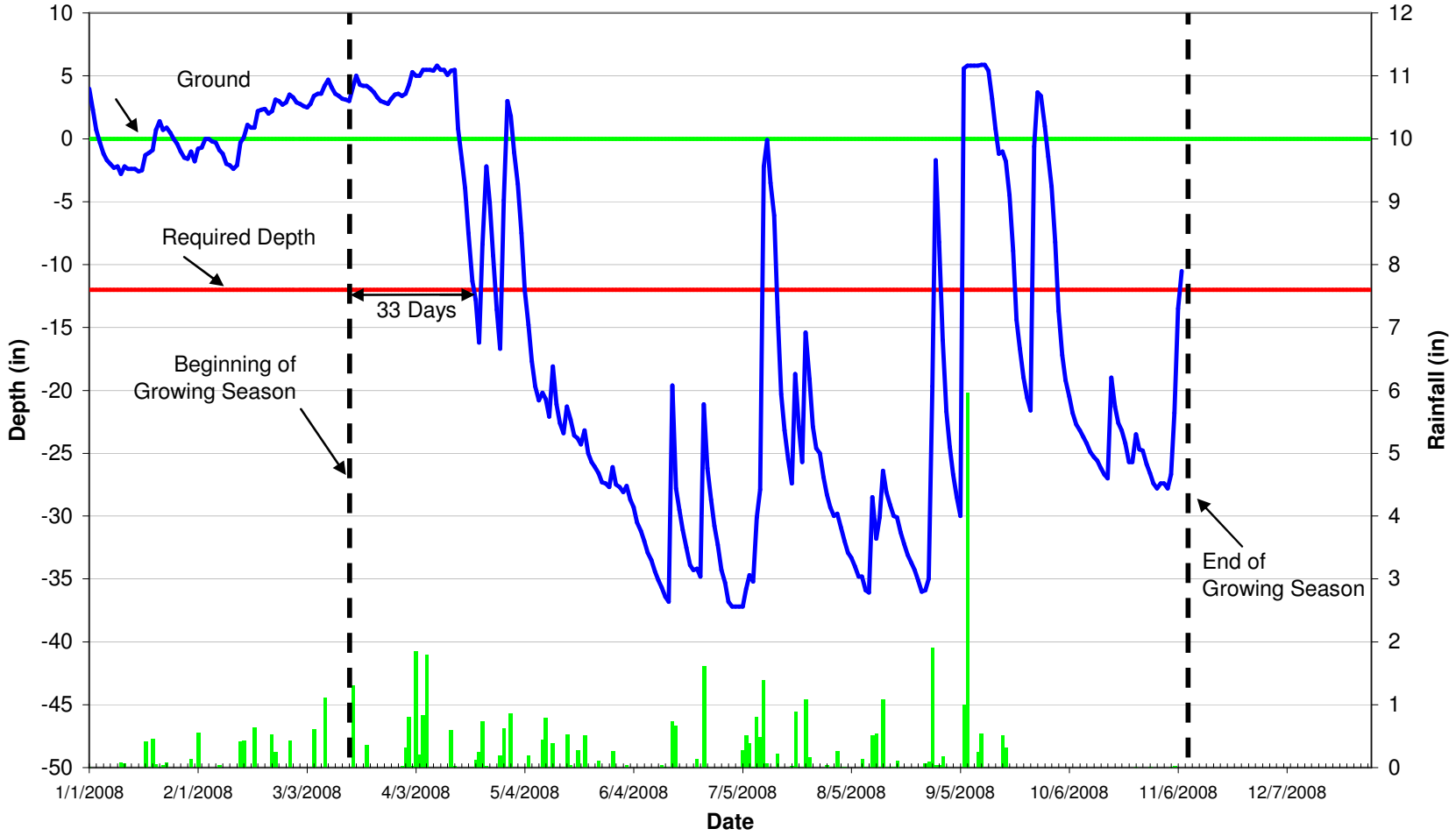


2008 Groundwater Data
Well JR-10 (SN: 00000A287F34)

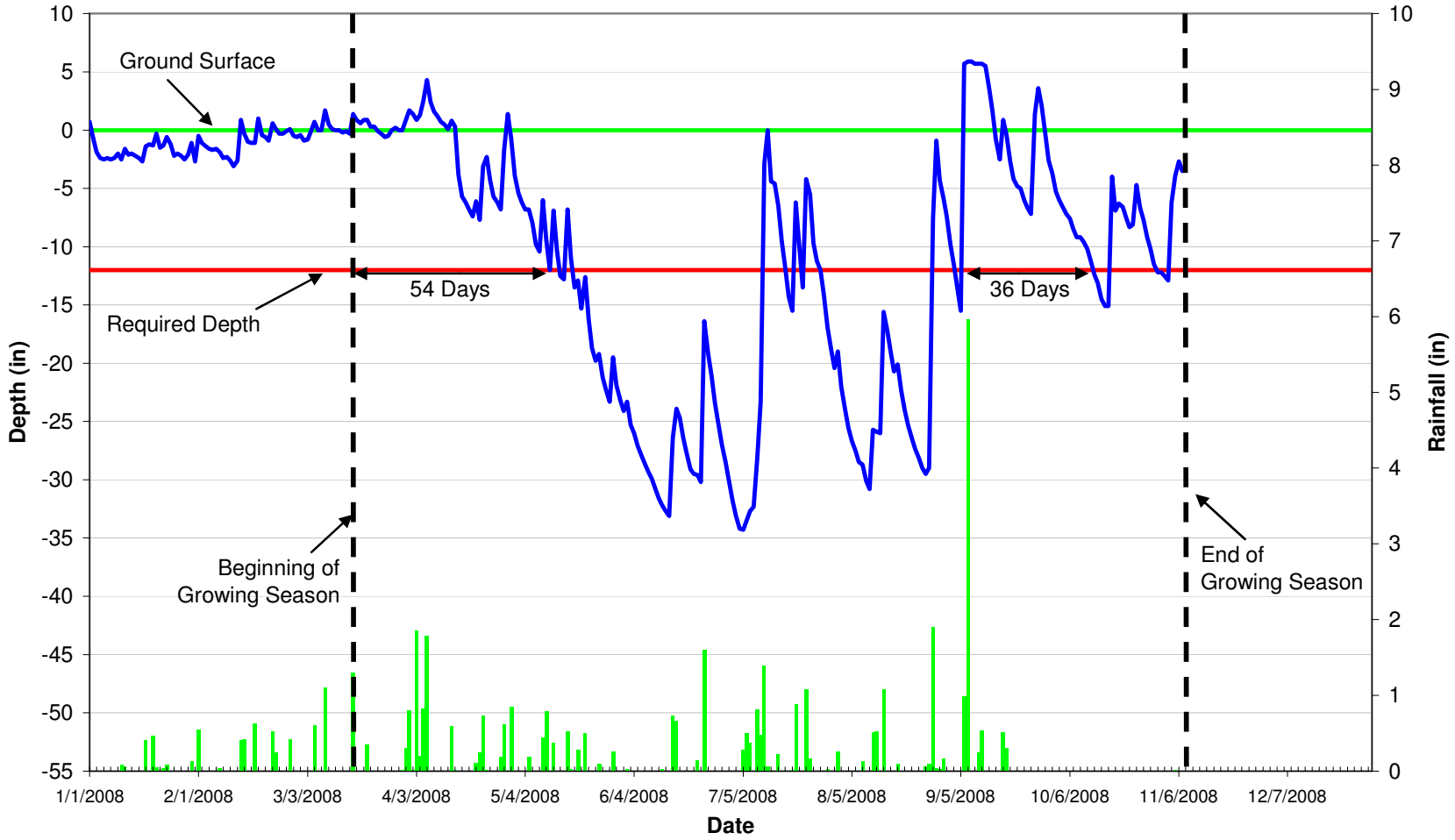


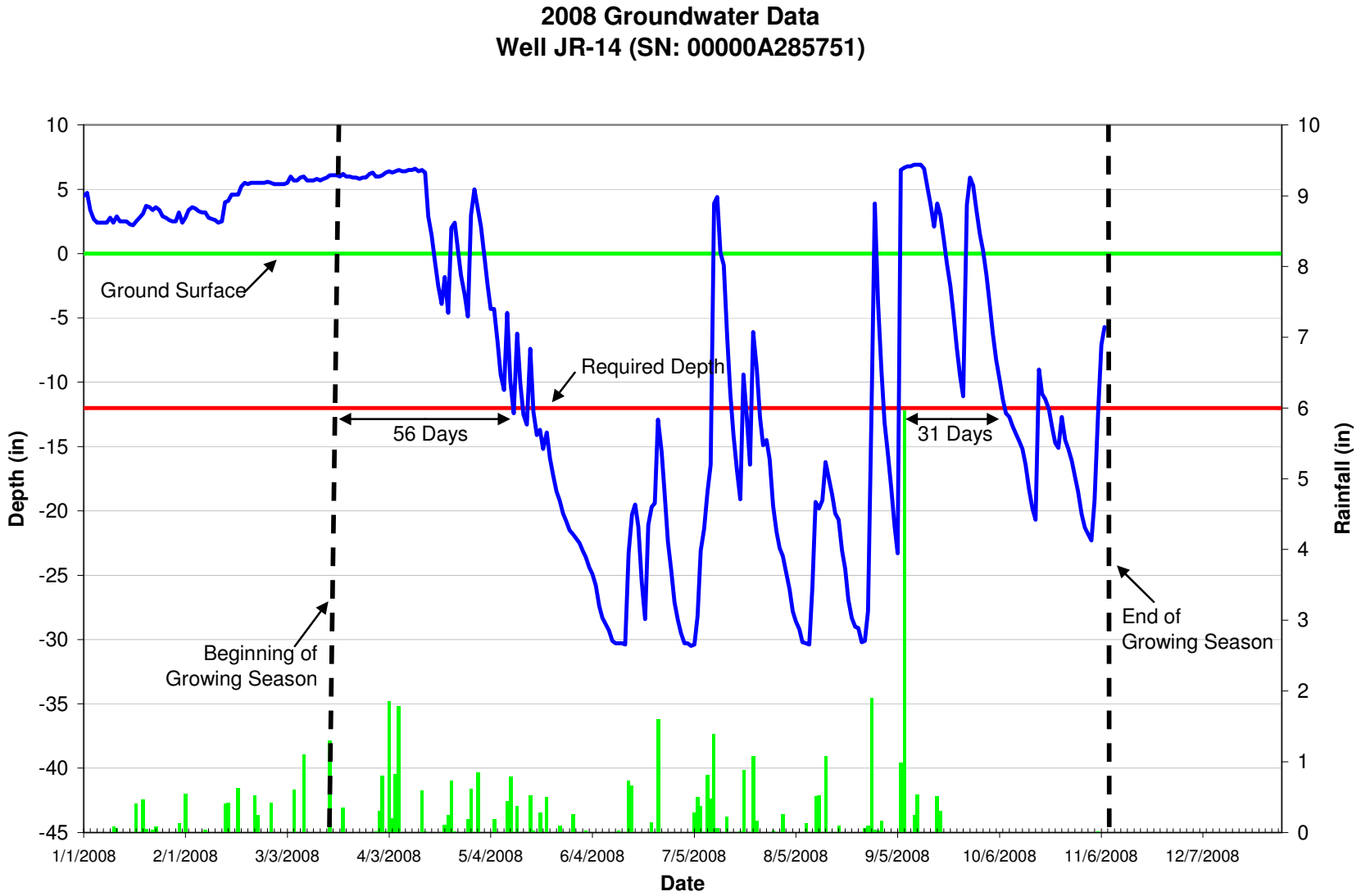

2008 Groundwater Data
Well JR-11 (SN: 00000A289B07)
Ground
Required Depth
39 Days
Beginning of
Growing Season
End of
Growing Season
Depth (in)
Rainfall (in)
Date
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
12
11
10
9
8
7
6
5
4
3
2
1
0
1/1/2008
2/1/2008
3/3/2008
4/3/2008
5/4/2008
6/4/2008
7/5/2008
8/5/2008
9/5/2008
10/6/2008
11/6/2008
12/7/2008

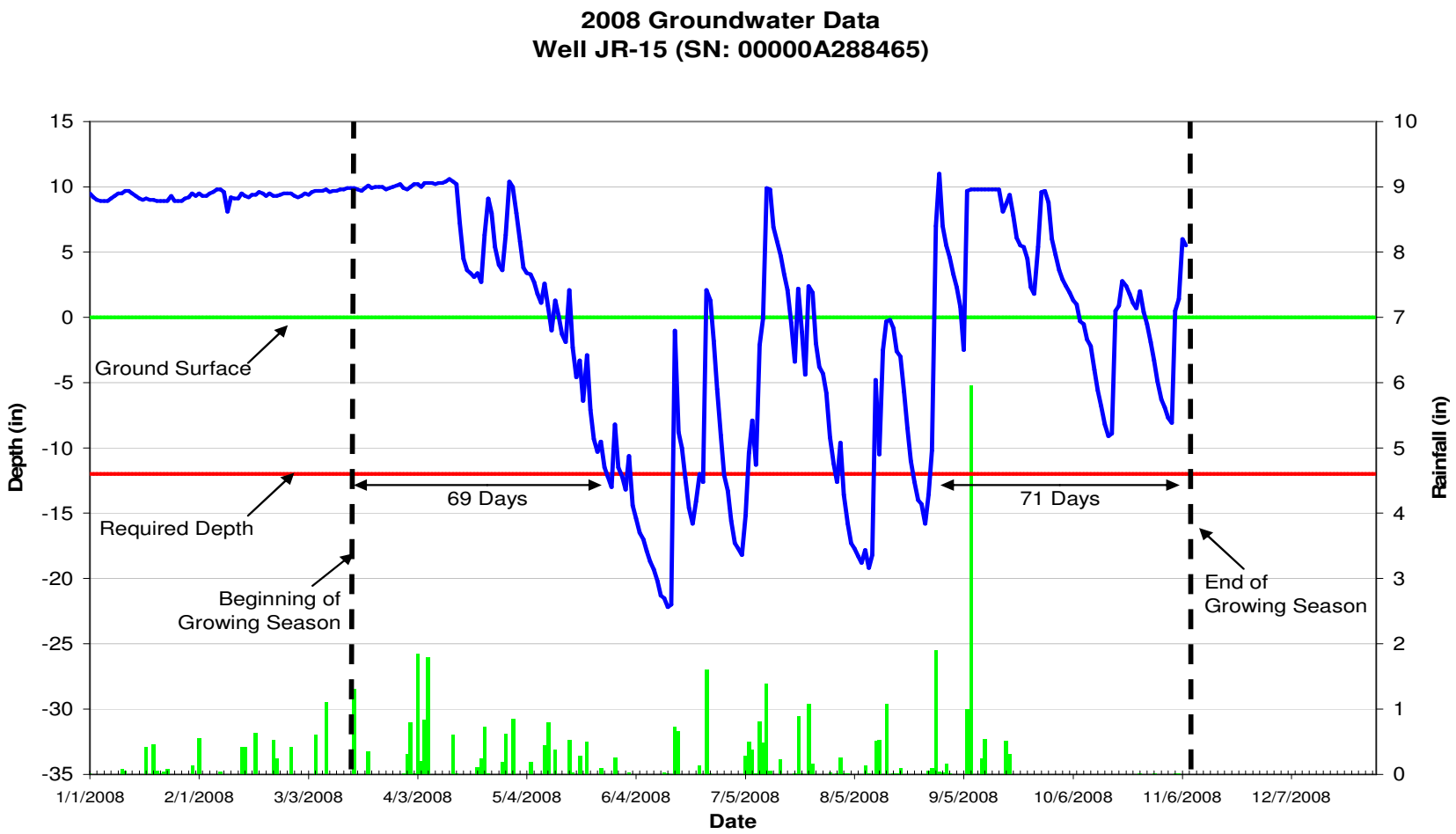
2008 Groundwater Data
Well JR-12 (SN: 00000AB3660B)



2008 Groundwater Data
Well JR-13 (SN: 00000A28BC50)




2008 Groundwater Data
Well JR-14 (SN: 00000A285751)
Depth (in)
Rainfall (in)
Date
Ground Surface
Required Depth
56 Days
31 Days
Beginning of Growing Season
End of Growing Season
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
9
8
7
6
5
4
3
2
1
0
1/1/2008
2/1/2008
3/3/2008
4/3/2008
5/4/2008
6/4/2008
7/5/2008
8/5/2008
9/5/2008
10/6/2008
11/6/2008
12/7/2008


2008 Groundwater Data
Well JR-15 (SN: 00000A288465)
Depth (in)
Rainfall (in)
Date
Ground Surface
Required Depth
Beginning of Growing Season
69 Days
71 Days
End of Growing Season
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
10
9
8
7
6
5
4
3
2
1
0
1/1/2008
2/1/2008
3/3/2008
4/3/2008
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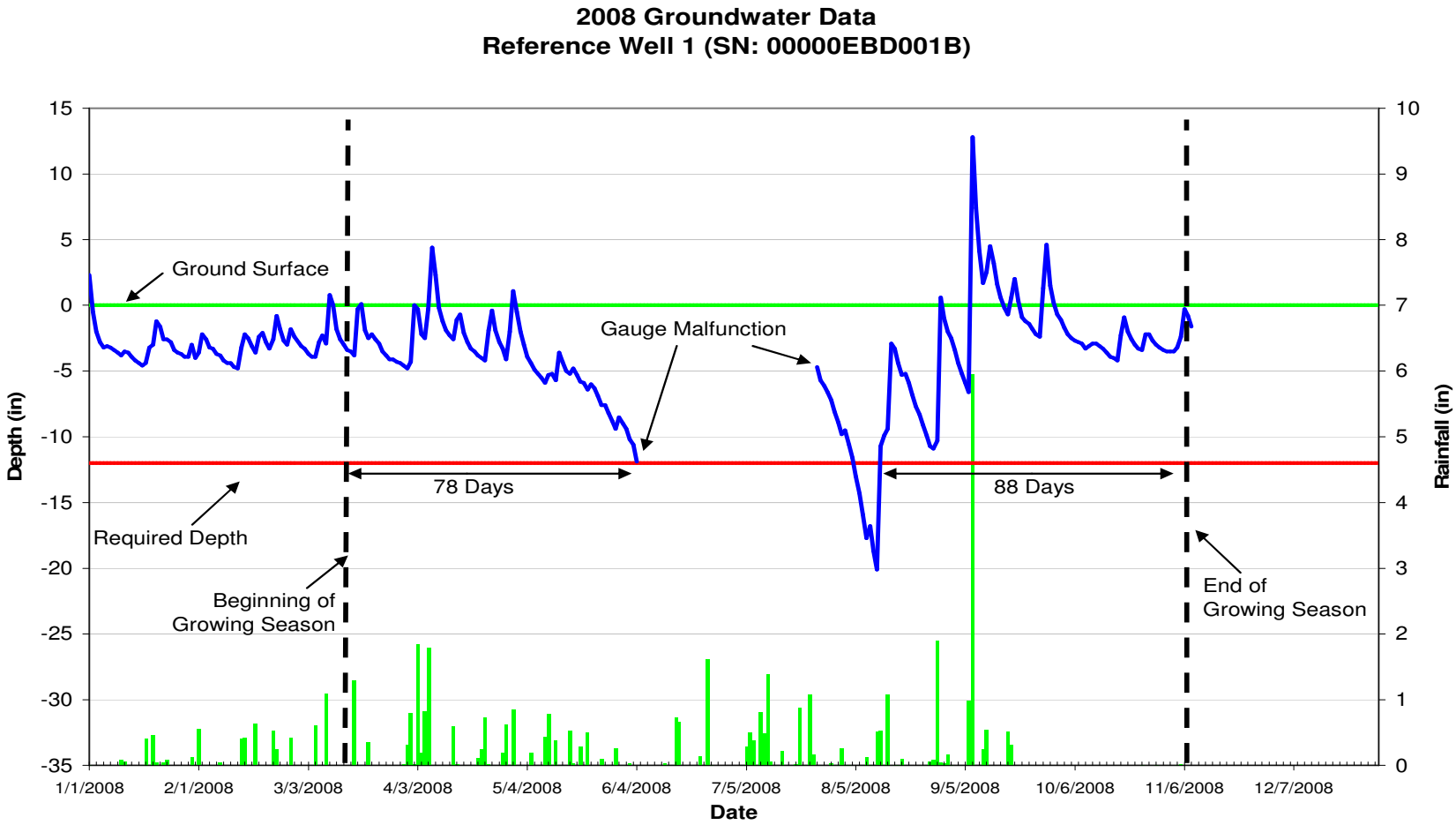
6/4/2008
7/5/2008
8/5/2008
9/5/2008
10/6/2008
11/6/2008
12/7/2008


2008 Groundwater Data
Reference Well 1 (SN: 00000EBD001B)
Depth (in)
Rainfall (in)
Date
Ground Surface
Gauge Malfunction
Required Depth
78 Days
88 Days
Beginning of Growing Season
End of Growing Season
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
10
9
8
7
6
5
4
3
2
1
0
1/1/2008
2/1/2008
3/3/2008
4/3/2008
5/4/2008
6/4/2008
7/5/2008
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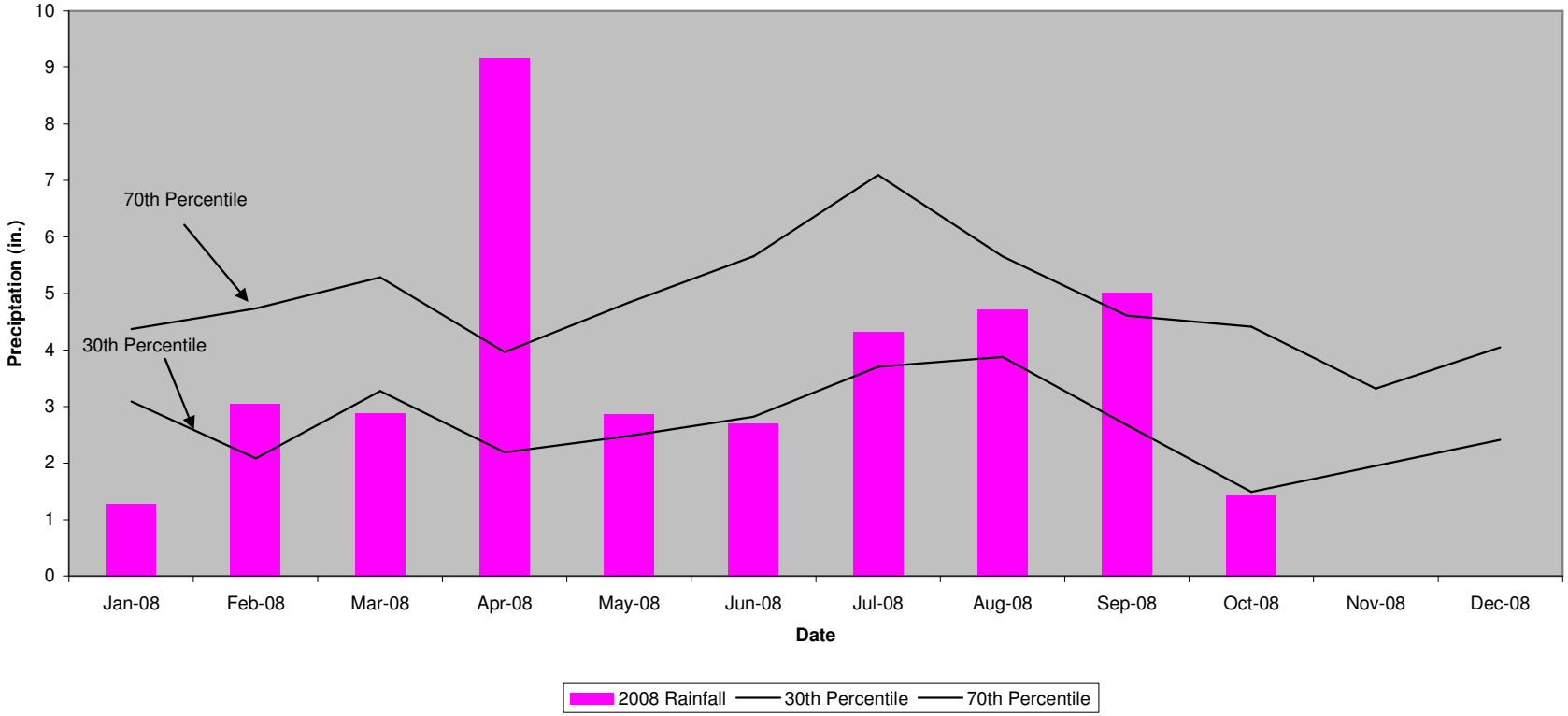
9/5/2008
10/6/2008
11/6/2008
12/7/2008

Overhills Stream 30-70 Percentile Graph
Harnett County, NC



Appendix D. Integrated Current Condition Plan View

See following page for Integrated Current Condition Plan View Map.

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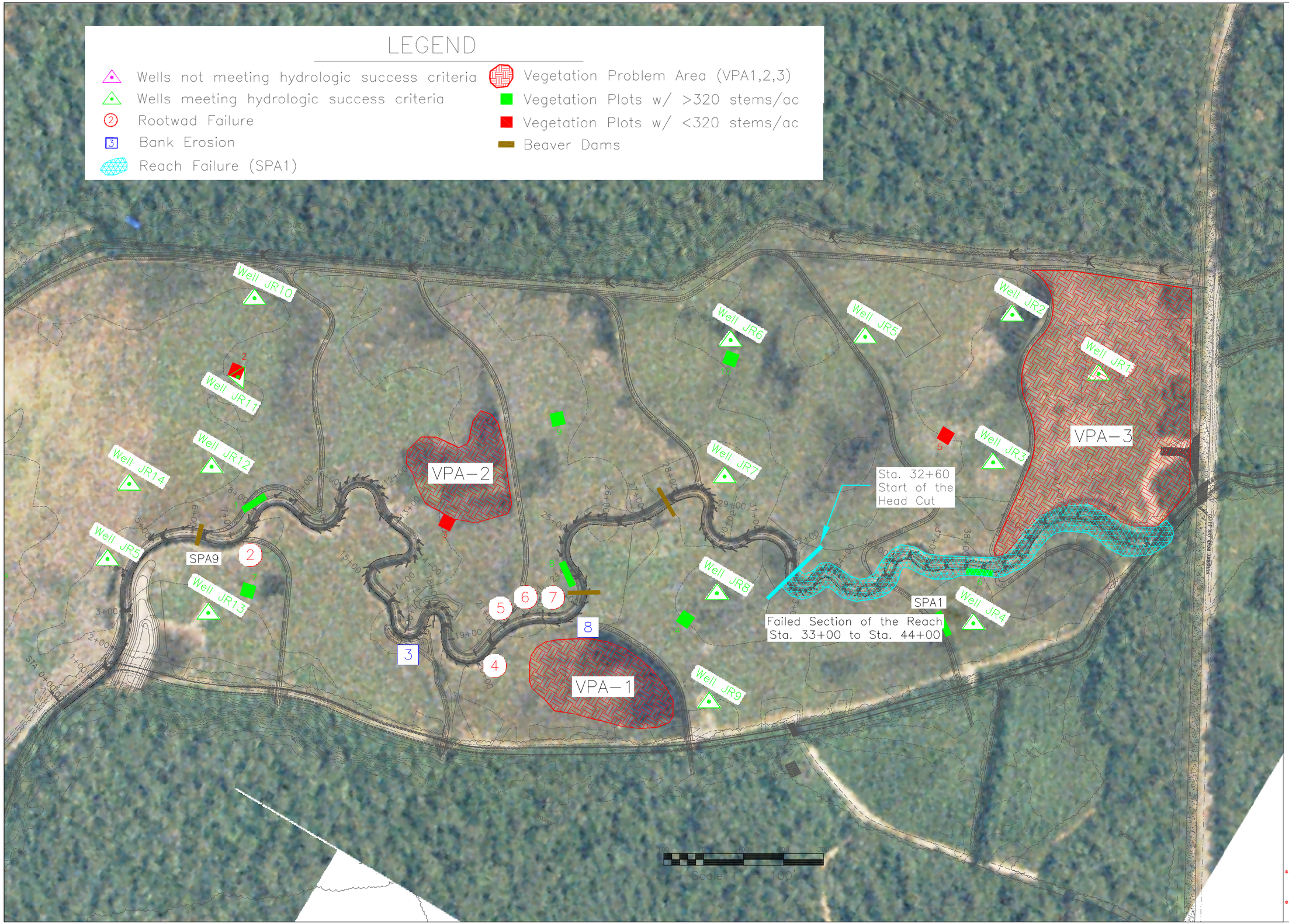

*** RECORD DOCUMENT ***
NCDOA File: 01-05249-01A
NCEEP Project: JR/CF/01
*** RECORD DOCUMENT ***

DAB		DRN
TXB		CHK
07/10/06	DRAFT REVISION 2 DESIGN	DATE
	REVISIONS	

Ecosystem Enhancement Program

Stantec Consulting Services Inc.
Suite 300, 801 Jones Franklin Rd
Raleigh, NC 27606
Tel. 919.851.6666
Fax. 919.851.7024
www.stantec.com

OVERHILLS
STREAM RESTORATION
Integrated Current Conditions Plan
APPENDIX D

Monitoring Year 2

NCEEP Project Number 199
Harnett County, NC

DATE	04/27/2009
PROJECT NO.	
FILENAME	.DWG
SHEET NO.	
DRAWING NO.	